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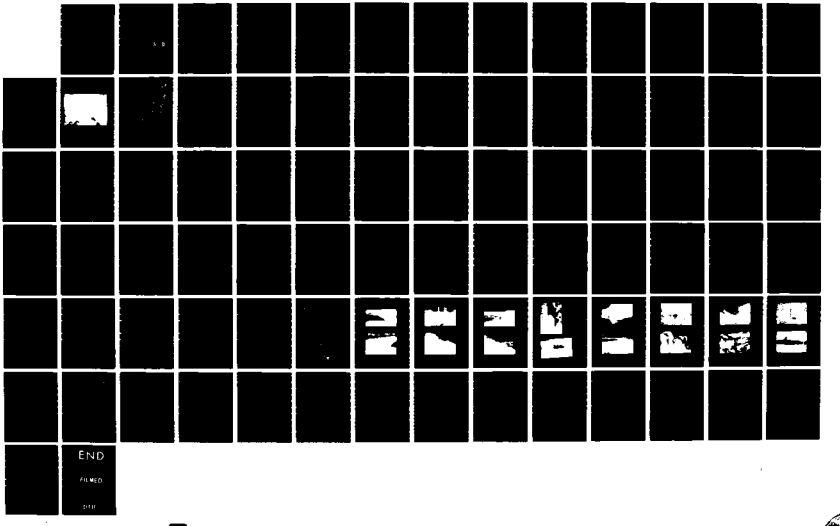

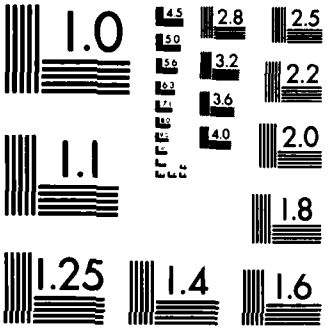

PAWTUXET RIVER BASIN
CRANSTON, RHODE ISLAND

CURRAN UPPER RESERVOIR DAM
RI 00702

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

MARCH 1980

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1. REPORT NUMBER: RI 00702	2. GOVT ACCESSION NO
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): Curran Upper Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS	5. TYPE OF REPORT & PERIOD COVERED: INSPECTION REPORT
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254	12. REPORT DATE: March 1980 13. NUMBER OF PAGES: 52
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,
Pawtuxet River Basin,
Cranston, Rhode Island,
Clarke Brook,

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is about 1200 ft. long and is an earth embankment structure with a concrete core wall. The dam is judged to be in poor condition with several deficiencies that require attention. It is small in size with a significant hazard potential. There are various remedial measures which must be undertaken by the owner.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

MAR 01 1990

Honorable J. Joseph Garrahy
Governor of the State of Rhode Island
and Providence Plantations
State House
Providence, Rhode Island 02903

Dear Governor Garrahy:

Inclosed is a copy of the Curran Upper Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Management, the cooperating agency for the State of Rhode Island. In addition, a copy of the report has also been furnished the owner, Dept. of Environmental Management, City of Rhode Island.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Management for your cooperation in carrying out this program.

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Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

CURRAN UPPER RESERVOIR DAM

RI 00702

PAWTUXET RIVER BASIN

CRANSTON, RHODE ISLAND

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE 1 - INSPECTION REPORT

IDENTIFICATION NO.:	RI 00702
NAME OF DAM:	Curran Upper Reservoir Dam
CITY:	Cranston
COUNTY AND STATE:	Providence County, Rhode Island
STREAM:	Clarke Brook
DATE OF INSPECTION:	1 November 1979

BRIEF ASSESSMENT

The dam at Curran Upper Reservoir is approximately 1,200 feet long (including the overflow spillway), and is an earth embankment structure with a concrete corewall. The embankment is about 27 feet high with an average crest width of 15 feet. Embankment slopes are graded at 1V on 2H and grassed on the downstream face and armored with stone on the upstream side. The overflow spillway is a concrete, granite, uncontrolled weir, 47 feet in length, located at the right abutment. The outlet works components consist of an intake tower in the reservoir pool, a 20-inch diameter blow-off pipe through the embankment and a concrete headwall structure at the downstream toe of the dam. An 18-inch diameter water supply pipe also passes through the embankment, from the tower to treatment facilities some distance from the dam. Discharges from the spillway or outlet conduit flow downstream through Clarke Brook to a lower reservoir. The Curran Upper Reservoir is used for recreational purposes.

The assessment of this dam is based on the visual inspection and review of existing drawings only, since engineering, operational, and maintenance records have not been maintained. The dam is judged to be in POOR condition with several deficiencies that require attention. These deficiencies include: deteriorated condition of the spillway channel and walls, extensive seepage along the toe of the dam and in the vicinity of the blow-off pipe, vegetal growth on the dam and its appurtenances.

The dam is classified as SMALL but a SIGNIFICANT hazard structure in accordance with the recommended guidelines established by the Corps of Engineers. The test flood outflow for this dam is equal to one-half the Probable Maximum Flood (PMF) or approximately 740 CFS and would not overtop this embankment. The test flood outflow of 740 cfs represents 80 percent of the total overflow spillway capacity of 923 cfs.

It is recommended that the Owner engage the services of a qualified, registered engineer to accomplish the following: analyze the impact of dam failure at this site to Curran Lower Reservoir; investigate and prepare measures to rehabilitate the overflow spillway; develop a monitoring procedure to evaluate the extensive seepage along the toe of the dam and, using the data retrieved, implement corrective procedures to reduce or control these flows; institute techniques to be included in a maintenance program to properly remove large diameter trees and their attendent root systems from the embankment slopes; and develop an emergency action plan.

Additional recommendations and remedial measures are included in Section 7 and should be implemented within one year after receipt of this Phase 1 report.

CE MAGUIRE, INC.

By _____
Richard W. Long, P.E.
Vice President

RICHARD W. LONG
No. 3529
REGISTERED
PROFESSIONAL ENGINEER

This Phase I Inspection Report on Curran Upper Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, DC 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or to property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the projedt for compliance with OSHA rules and regulations is also excluded.

TABLE OF CONTENTS

d. Reservoir Area. No specific detrimental features in the reservoir area were observed during the visual inspection. The slopes of the shoreline are flat and well covered with grass and vegetation to preclude sloughing of shoreline materials. The north and east shoreline areas are used as pasture land at present.

e. Downstream Channel. The downstream channel for the spillway and outlet works is the natural streambed of Clarke Brook which meanders downstream a distance of about 2,000 feet where it discharges into Curran Lower Reservoir. The stream bed is densely overgrown with vegetation with many large diameter trees present.

3.2 Evaluation

On the basis of the visual inspection, the dam is judged to be in POOR condition because of the following features:

a. Extensive seepage along the toe of the dam can lead to future erosion and piping.

b. Deterioration of the spillway walls, particularly of the left wall, at the toe of the dam, can lead to collapse of the walls under flood conditions. Collapse of the left wall would threaten the stability of the downstream slope of the dam and could induce sloughing of the embankment.

c. The growth of bushes in the spillway channel presents an obstruction to flow and an increased danger of erosion of the walls and an unnecessary increase in stage for the spillway discharges.

d. Deterioration of the spillway weir can lead to its failure during floods.

e. Growth of trees on the downstream and upstream slopes can lead to seepage paths along rotting tree roots after the trees die and removal of soil from the slope by trees uprooted during storms.

f. The piers for the bridge over the spillway can collect debris during floods and reduce the spillway flow.

g. Lost gate handles to operate the outlet works conduit valve.

h. Sloughing of the crest shoulder on the upstream slope of the dam and the incomplete coverage of riprap for protection against wave action.

c. Appurtenant Structures.

1. Spillway - The spillway is located at the right end of the dam. A pedestrian bridge crosses over the spillway. (See Photo C-9). The piers, with about a 12-foot spacing, could accumulate debris during floods, clogging the spillway. The spillway has a rectangular weir, a downstream view of which is shown in Photo C-10. According to the 1902 drawings, the cap of the weir consisted of granite blocks. Presently a concrete cap covers the granite blocks. The water level in the reservoir was slightly below the crest of the spil'way; however, a substantial amount of water could be seen flowing through the joint between the top concrete layer and the granite blocks. The concrete below the granite blocks shows considerable spalling. The right training wall, built against the right abutment, has developed differential lateral displacements across a construction joint of about one inch. Both training walls show considerable spalling and efflorescence. (See Photo C-16). The downstream channel is parallel to the dam from Sta 0+00 to about Sta 3+00 (Photo C-13) and the left wall of the channel is at the toe of the dam. The left channel wall shows considerable spalling and seepage with some trees growing out of the wall (Photo C-3). The channel bottom is paved with stones and shows growth of bushes.

2. *Outlet Works* - The outlet works consists of a gatehouse and intake tower, an 18-inch diameter supply pipe, and a 20-inch diameter blow-off pipe through the embankment and a concrete face headwall and outlet at the downstream toe of the dam. According to the existing drawings, the inlet to the gatehouse tower is a 2 feet x 2 feet screened opening at the bed of the reservoir. Both the supply and blow-off pipes are cast iron with iron and portland cement seep collars to prevent seepage along the outside perimeter of the lines. The supply line continues downstream underground beyond the damsite while the blow-off pipe daylights at the downstream toe of the embankment at a headwall structure.

   The location of the gate handle to operate the outlet valves is unknown and most probably the equipment is lost.

   The gatehouse is partially demolished, and its remains are presently inaccessible from the dam (Photo C-8). The blow-off pipe outlet is located at a headwall at the toe of the dam. The headwall shows severe spalling and seepage exiting at its base (Photos C-7 & C-12). The supply pipe does not exit in the vicinity of the dam and thus could not be observed.

SECTION 3
Visual Inspections

3.1 Findings

a. General. The Phase 1 inspection of the dam at Curran Upper Reservoir was performed on 1 November 1979 by representatives of CE Maguire, Inc. and Geotechnical Engineers Inc. The inspection team was accompanied in the field by Mr. Carmen Asprinio, Civil Engineer, Land Resources - Department of Environmental Management, State of Rhode Island.

Based on the visual inspection, history, and general appearance, the dam at Curran Upper Reservoir and its appurtenances are judged to be in POOR condition.

b. Dam. The dam is an earth embankment with a concrete corewall. As-built drawings, dated 1902, indicate that the corewall extends generally between 10 feet and 20 feet below the original ground surface. At the base of the corewall the foundation is described at different points along the length as bedrock, sand, clay and hardpan.

The upstream slope is heavily overgrown with bushes and saplings. It is generally covered with riprap (Photos C-1, 2), but in some areas the riprap is missing. In those areas, sloughing of the crest shoulder on the upstream slope of the dam has occurred. The crest is grass covered (Photos C-5, 6) and shows no signs of erosion.

The downstream slope is overgrown with trees and bushes. Some of the larger trees can be seen in Photos C-3 and C-4. Access stairs have been built on the slope in two locations. Extensive seepage was observed at the toe of the slope primarily between Sta 8+00 and 9+00 and between Sta 3+00 and 5+50. In some of the seepage areas the lower footage of the slope appeared soft and wet, even though no seepage could be observed flowing out of the slope. The seepage exiting out of the toe could be observed after clearing the cover of leaves. (See Photo C-11). At about Sta 4+25, there is standing rust-colored water and vegetation typical of wet areas. The seepage flows downstream and to the right towards the outlet channel which is the natural streambed. Some animal burrows exist on the slopes (Photo C-15).

A few footpaths were observed on the downstream slope which have resulted in local erosion of up to one foot below the slope surface. (See Photo C-14).

SECTION 2

ENGINEERING DATA

2.1 Design Data

The following documents which contain the principal information regarding this dam were reviewed in the preparation of this report.

1. Plan of a Dam Built for the Pawtuxet Valley Water Company at Fiskeville, Rhode Island - J.A. Latham, Engineer, 1902, Sheet 1.

2. Detail Plan of a Dam Built for the Pawtuxet Valley Water Company, Sheet 2.

3. Gatehouse at Dam Built for the Pawtuxet Valley Water Company, Sheet 3.

4. Plan of a Proposed Dam at Fiskeville, Rhode Island for the Pawtuxet Valley Water Company by J. A. Latham, 1902.

5. Estimate Sheet - Showing quantities needed in erection of Dam and a general plan showing location of proposed Borrow Pits by J. A. Latham, 1902.

2.2 Construction Data

No record of construction or repairs exists to supplement the above information.

2.3 Operation Data

The reservoir is presently used for recreation and is not regulated. No operating records for this facility have been maintained.

2.4 Evaluation of Data

a. Availability. The information noted above for this facility is available from the files of the Dam Section - Land Resources - Department of Environmental Management, State of Rhode Island.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspections, past performance and sound judgment.

c. Validity. The validity of the limited data must be verified.

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3.	Height	27.0 feet
4.	Top Width	15.0 feet
5.	Side Slopes	1V on 2H
6.	Zoning	None
7.	Impervious Core	Concrete corewall
8.	Cutoff	Corewall extends to rock.
9.	Grout curtain	None
10.	Other	--

h. Spillway

1.	Type	Stone masonry, overflow, ungated, free vertical fall.
2.	Length of weir	47.0 feet
3.	Crest elevation	328.0 feet
4.	Gates	None
5.	U/S Channel	Straight approach, natural reservoir bed.
6.	D/S Channel	Natural streambed of Clarke Brook.
7.	General	--

i. Regulating Outlet

1.	Invert Elevation	307.41 feet
2.	Size	20-inch diameter pipe
3.	Description	Cast iron pipe
4.	Control Mechanism	Manually operated, sluice gates.
5.	Other	Abandoned 18 inch dia. water supply line to downstream treatment plant.

2.	Recreation Pool	2,000
3.	Flood Control Pool	N/A
4.	Test Flood Pool	2,000
5.	Spillway Crest	2,000

e. Storage (Acre-Feet)

1.	Recreation pool	390
2.	Flood control pool	N/A
3.	Test flood pool	490
4.	Spillway crest pool	390
5.	Top of dam	500
6.	Net storage between top of dam (Elev. 331.50) and spillway crest is 112 Ac.-Ft. and represents 2.26 inches of runoff from the drainage area of 0.93 square miles.	
7.	Each foot of surcharge storage from spillway crest to top of dam equals 0.64 inches of runoff.	

f. Reservoir Surface (Acres)

1.	Recreation pool	32
2.	Flood control pool	N/A
3.	Spillway crest	32
4.	Test flood pool	34
5.	Top of dam	34

g. Dam

1.	Type	Earth embankment with concrete corewall.
2.	Length (including spillway)	1200 feet

1. Outlet Works

Conduit Size	20-inch diameter pipe
Invert Elevation	307.41 feet
i. Discharge Capacity at Spillway Level (Elev. 328.0 feet)	49 CFS
ii. Discharge Capacity at Top of Dam Elev. 331.5	53 CFS
iii. Discharge Capacity at Test Flood Level (Elev. 331.01)	52 CFS

2.	Maximum known flood at damsite	Unknown
3.	Ungated spillway capacity at top of dam	923 CFS
4.	Total project discharge at top of dam (spillway plus outlet)	976 CFS
5.	Total project discharge at test flood level (Spillway only)	740 CFS

c. Elevations (Feet above NGVD)

1.	Streambed at centerline of dam	304.50
2.	Maximum tailwater	Unknown
3.	Upstream portal invert	Unknown
4.	Recreation pool	328.0
5.	Full flood control pool	N/A
6.	Spillway crest (ungated)	328.0
7.	Design surcharge (original design)	Unknown
8.	Top of Dam	331.50
9.	Test flood level	331.01

d. Reservoir Lengths (Feet)

1.	Maximum Pool	2,000

g. Purpose of Dam. The dam was originally constructed as a water supply source for the Pawtuxet Valley Water Company but is presently owned by the State of Rhode Island and managed as a recreational facility.

h. Design and Construction History. Record drawings indicate that the dam was constructed about 1902 to provide a water supply for the Pawtuxet Valley Water Company.

About August, 1946, this water supply reservoir was set aside for stand-by storage only. In 1968, the ownership of the dam and reservoir was transferred to the State of Rhode Island and added to the State Park System. No records of repairs or maintenance are available that document subsequent work at the site.

i. Normal Operational Procedures. Water levels in Curran Upper Reservoir are uncontrolled. The gates are not used to regulate the water level and appear to be inoperative.

1.3 Pertinent Data

a. Drainage Area. The Curran Upper Reservoir drainage basin, located in the western part of the City of Cranston, Rhode Island, is generally rectangular in shape with a length of 7,000 feet, a width of 4,000 feet, and a total drainage area of 0.93 square miles. (See Appendix D for Basin Map). One percent of the catchment or 0.01 square miles is natural, storage areas or swamps. The topography is steep and rolling with elevations ranging from a high of 500 feet at Bald Hill to elevation 328 feet (NGVD) at the spillway crest. Basin slopes average 0.03 feet/feet and are considered steep. The time of concentration for the entire catchment area is estimated to be 30 minutes and increases the probability that the surface runoff will peak simultaneously at the reservoir site during a high intensity rainfall event. The small swamp area within the basin has very little effect on attenuating the peak runoff.

b. Discharge at Damsite. There are no records available for discharges at this facility. The files of the Department of Environmental Management - State of Rhode Island indicates the estimated extreme freshet calculated at this dam is equal to 135 CFS. Listed below are discharge data and other pertinent information.

Pawtuxet River at Fiskeville. The axis of the dam is oriented in an east-west alignment with the reservoir located north of the dam.

b. Description of the Dam and Appurtenances. The dam at Curran Upper Reservoir is approximately 1,200 feet in length (including the overflow spillway), and is an earth embankment structure with a concrete corewall. The overflow spillway is a concrete and granite, uncontrolled weir, approximately 47 feet in length, located at the right abutment of the dam. The outlet works structure is located approximately 335 feet from the right abutment at the upstream toe of the dam and has one gated 20-inch cast iron conduit and one gated 18-inch cast iron water supply pipe. Discharges from the spillway and outlet works flow into Clarke Brook which leads to Curran Lower Reservoir about 2,000 feet downstream.

c. Size Classification. Curran Upper Reservoir Dam has an impoundment capacity at the top of the dam (Elev. 331.50 NGVD) equal to 500 Ac.-Ft. and a maximum height of 27.0 feet. In accordance with the guideline criteria established by the Corps of Engineers, this dam is classified as SMALL in size.

d. Hazard Classification. This dam is classified as having a SIGNIFICANT hazard potential because its failure may result in downstream property damage to an overhead power line crossing 1,800 feet below the dam, overtopping of Curran Lower Reservoir and residential property in the Lippitt Hill area of Cranston. Overtopping of the lower reservoir will result in loss of more than a few lives and as a minimum, 10 dwellings. Estimated water depths due to the failure discharge from Curran Upper Reservoir of 13,890 CFS range from 12 feet immediately downstream of the dam to 10.8 feet at a distance of 2,000 feet where Clarke Brook joins Curran Lower Reservoir. The estimated rise in the water surface in Curran Lower Reservoir due to failure of the Curran Upper Reservoir pool dam is equal to 9 feet. This failure discharge will cause flooding, high velocities, and carry large quantities of debris from the wooded streambanks of Clarke Brook.

e. Ownership. Curran Upper Reservoir is owned by the State of Rhode Island and is operated and managed by the Department of Environmental Management, Division of Land Resources.

f. Operator. Operating personnel are under the direction of:

Mr. Peter Janaros, Chief
Division of Land Resources
Department of Environmental Management

NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

NAME OF DAM: CURRAN UPPER RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army through the Corps of Engineers to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. CE Maguire, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Rhode Island. Authorization and notice to proceed was issued to CE Maguire, Inc., under a letter from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW33-80-C-0013 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection.

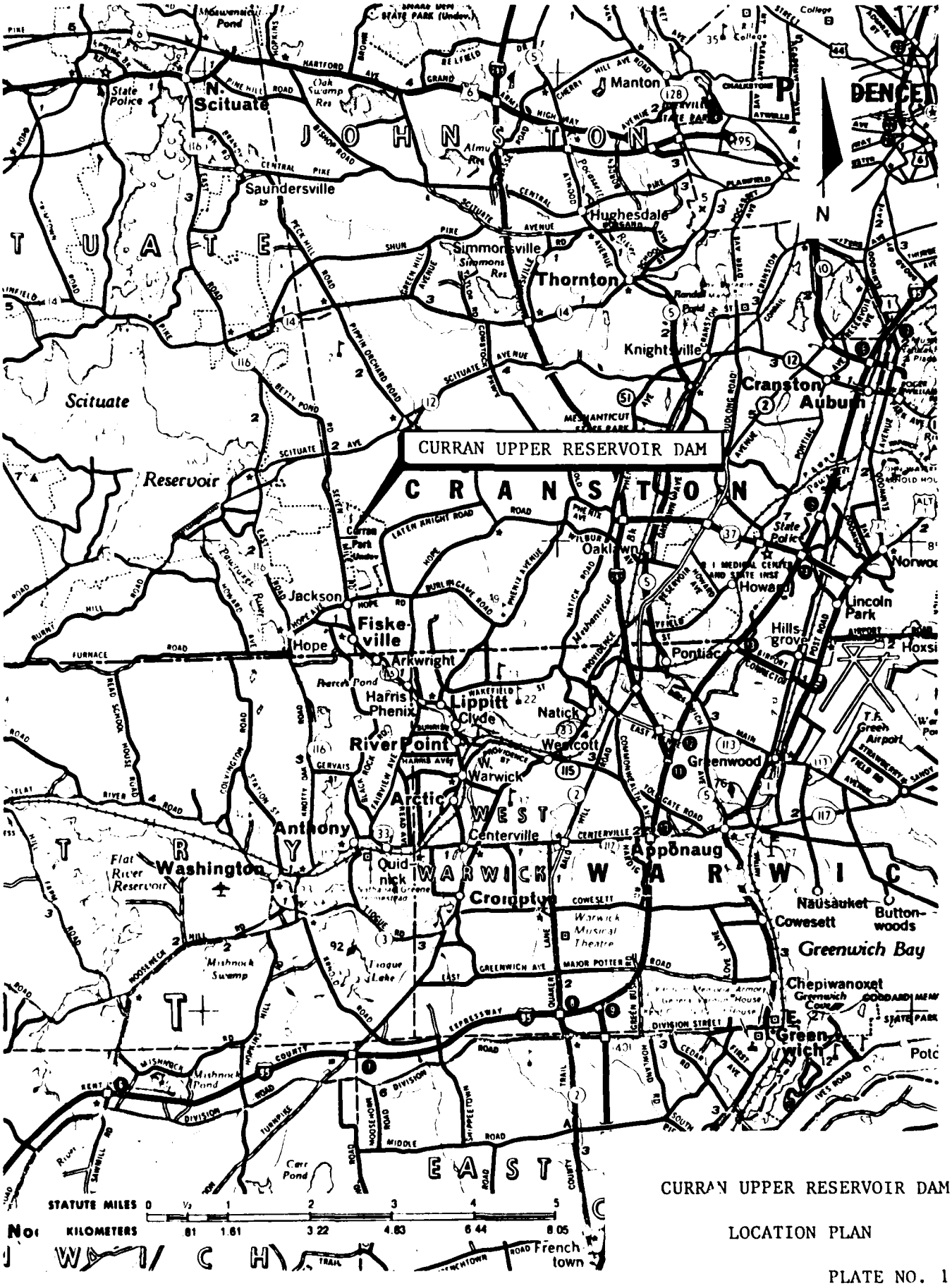
1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

3. To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Curran Upper Reservoir is located in the Town of Cranston, Providence County, Rhode Island, approximately 1.0 mile south of Scituate Avenue (RI Route 12) along Seven Mile Road. Coordinates of the dam are approximately 41° 45.0' N Latitude and 71° 33.1' W Longitude. The dam impounds water from Clarke Brook which drains a 0.93 square mile watershed of rolling terrain. The dam is located about 7,000 feet upstream from the confluence of Clarke Brook and the North Branch of the



CURRAN UPPER RESERVOIR DAM

LOCATION PLAN

PLATE NO. 1

OVERVIEW PHOTO - J. L. CURRAN RESERVOIR DAM

APPENDICES

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. The storage at Curran Upper Reservoir is maintained for recreational purposes only by the Owner. The impoundment is not regulated, and all downstream discharges are the result of overflow through the spillway. There has been no regulation or operation of the gates since 1968 when the State of Rhode Island, the present Owner, acquired the property. No formal emergency action procedure has been developed or implemented for the facility. Because of its remote location, it is assumed that abutting property owners would notify authorities in emergency situations.

b. Descriptions of any Warning System in Effect No warning system is in effect for this dam.

4.2 Maintenance Procedures

a. General There is no specific maintenance program for this dam.

b. Operating Facilities Operating facilities have not been maintained. It could not be determined by the visual inspection, review of available data, or discussions with the present Owner whether the 18 inch diameter water supply has been permanently plugged. Use of this additional outlet for rapid drawdown of the pool should be considered.

4.3 Evaluation

There is no regularly scheduled maintenance program. The Owner's representatives periodically visit the dam. A systematic and complete inspection and maintenance program should be instituted at the dam. An Emergency Action Plan also needs to be developed and implemented that will provide the Owner with adequate time to respond to critical situations.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General. The dam at Curran Upper Reservoir is located on Clarke Brook, approximately 1.0 mile south of the intersection of Scituate Avenue and Seven Mile Road in the western area of the City of Cranston, Rhode Island. The dam was originally owned by the Pawtuxet Valley Water Company and operated as a water supply facility; however, the present Owner, the State of Rhode Island - Department of Environmental Management, maintains the reservoir for recreation only. The catchment area is equal to 0.93 square miles and is undeveloped woodland.

The dam is an earth embankment, 1,200 feet long, with an overflow spillway length of 47 feet and a surcharge height between the top of the dam and the spillway crest equal to 3.5 feet. The reservoir has a total storage capacity of 390 Ac.-Ft. at the spillway crest level and can accommodate 6.61 inches of effective runoff from the watershed. There is 112 Ac.-Ft., equivalent to 2.26 inches of runoff available in surcharge which makes this a small storage facility. The test flood outflow discharge for this dam is equal to 740 cfs which represents 80 percent of the maximum spillway discharge which equals 923 cfs. Therefore, the dam is considered a high spillage facility. Because the dam is an earth embankment, it is less stable against potential overtopping than other types of dams.

5.2 Design Data. No specific design data is available for this watershed or structure. In lieu of existing design information, U.S.G.S. Topographic Maps (Scale 1" = 2,000') were utilized to develop hydrologic parameters such as drainage area, reservoir surface area, basin slopes, time of concentration and other runoff characteristics. Elevation - storage relationships for the reservoir were approximated. Surcharge storage was computed assuming the surface area remained constant above the spillway crest. Some of the pertinent hydraulic design data was obtained and/or confirmed by actual field measurements at the time of visual field inspection.

Test flood inflow/outflow values and dam failure profiles were determined in accordance with the Corps of Engineers Guidelines. Final values in this report are quite approximate and are no substitute for actual detailed analysis.

5.3 Experience Data. No historical data for recorded discharges or water surface elevations is available for this dam or watershed.

5.4 Test Flood Analysis. Recommended guidelines for the Safety Inspection of Dams by the Corps of Engineers were used for selection of the "Test Flood". This dam is classified under those guidelines as a SIGNIFICANT hazard and small in size. Guidelines indicate that a 100 yr. event to one-half P.M.F. be used as range of test floods for such a classification. The watershed has a total drainage area of 0.93 square miles, of which 0.01 square miles is swampy. This drainage area is undeveloped, wooded, and hilly with rolling terrain. The basin slope average is 0.03 feet/feet which is considered steep. A "test flood" equal to one-half P.M.F. was calculated to equal 1,000 CSM or 930 CFS. Outflow discharges were also developed using the Corps of Engineers criteria for approximate routing. The outflow discharge for the test flood inflow was 740 CFS. The spillway and outlet rating curves are illustrated in Appendix D. Flood routings were performed assuming the initial reservoir pool was at the spillway crest level.

Calculations indicate that the spillway capacity is hydraulically adequate to pass the "test flood" (one-half P.M.F.) and overtopping of the dam would not occur. The test flood outflow discharge for this dam is equal to 740 cfs which represents 80 percent of the maximum spillway discharge which equals 923 cfs.

At the spillway crest level, Elev. 328.0 feet, the capacity of the outlet works is 200 CFS. It will require 2 hours to lower the reservoir level the first foot, assuming the pool surface area is 32 acres. For the 389 Ac.-Ft. of available storage below the spillway crest, it will require about 2 days to drain this reservoir through the existing outlet if required in an emergency situation assuming no inflow in the interim.

5.5 Dam Failure Analysis. An instantaneous full-depth/partial width breach of 55.0 feet was assumed to have occurred at this dam. This will result in an unsteady flow phenomenon with one flood wave travelling up into the reservoir to feed the other wave travelling downstream into the valley.

The calculated dam failure discharge of 13890 CFS, assuming the impounded water level is at the top of the dam (Elev. 331.50) initially, will produce an approximate water surface flood wave stage of 316.5 feet immediately downstream from the dam. This will raise the water surface about 9.0 feet above the depth just prior to failure when the discharge is 923 CFS. The failure analysis covered the reach extending from the dam to a point a distance of 2,000 feet downstream. It is assumed that normal uniform flow, following Manning's formula, will occur at that point; and the depth of flow will equal 10.8 feet. The depth of flow will vary from 12 feet at the dam to 10.8 feet at the lower reservoir. It is estimated that the water surface in

Curran Lower Reservoir will rise 9 feet from the instantaneous failure discharge. The failure discharge will diminish as the pool is emptied and the depth decreased. The wooded terrain between the two bodies of water will tend to diminish the flow and velocity of the failure discharge, but will also provide a source of debris that will enter the lower pool. It is estimated that the maximum depth of water due to the failure of Curran Upper Reservoir will be 12 feet and will occur at the downstream toe of the dam and the maximum velocity will be 39 ft./sec.

Failure of Curran Upper Reservoir dam may result in damage to an overhead power line crossing 1,800 feet below the dam, overtopping of Curran Lower Reservoir and residential property in the Lippitt Hill area of Cranston. Overtopping of the lower reservoir will result in loss of more than a few lives and as a minimum, 10 dwellings.

CURRAN UPPER RESERVOIR DAM

Inflow, Outflow, and Surcharge Data

FREQUENCY IN YEARS	24-HOUR TOTAL RAINFALL IN INCHES	24-HOUR** EFFECTIVE RAINFALL IN INCHES	MAXIMUM INFLOW IN C.F.S.	MAXIMUM** OUTFLOW IN C.F.S.	SURCHARGE HEIGHT IN FEET	SURCHARG STORAGE ELEVATI(
½ PMF = Test Flood	11.9	9.5	930	740	3.01	331.01

* Infiltration assumed as 0.1"/hour
** Lake assumed initially full at spillway crest elevation 328.0
(top of dam = 331.50 +)

NOTES:

1. ½ PMF and "test flood" computation based on COE instructions and guidelines.

2. Maximum capacity of spillway without overtopping the top of the dam elevation (331.50) is equal to 923 CFS.

3. Surcharge storage is allowed to overtop the dam when exceeding the spillway capacity.

4. Test flood = one-half PMF = 1,000 CSM = 930 CFS
(D.A. = 0.93 square miles).

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations. The visual inspection did not disclose any indications of present structural instability. The future stability can be affected by the features discussed in Section 3.2.

6.2 Design and Construction Data. The design and construction data consists of plans showing a plan and cross section of the dam. A concrete core wall is shown, but no information is presented on the type of soil in the earth embankment. Thus, the evaluation of stability is based on the visual inspection only.

6.3 Post-Construction Changes. There are no known post-construction changes.

6.4 Siesmic Stability. The dam is located in Seismic Zone 1 and in accordance with the recommended Phase 1 inspection guidelines does not warrant seismic stability analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. On the basis of the visual inspection, the dam is judged to be in poor condition, as evidenced by the following:

1. Extensive seepage along the toe of the dam.

2. Deterioration of the concrete spillway and of the walls of the spillway channel, particularly the wall along the toe of the dam.

3. Heavy growth of trees and bushes on the downstream and upstream slopes and in the spillway channel.

4. Obstruction to spillway discharge by potential accumulation of debris against the spillway bridge piers.

b. Adequacy of Information. The available information was judged sufficient for a Phase I inspection.

c. Urgency. The recommendations presented in Sections 7.2 and 7.3 should be carried out within one year of receipt of this report by the Owner.

7.2 Recommendations

The following recommendations should be carried out under the direction of a qualified registered engineer:

a. Design repairs to the spillway training walls and weir and to the walls of the spillway channel. Consideration should be given to seepage control measures behind the left wall of the spillway channel that is located along the toe of the dam.

b. Investigate the significance of the extensive seepage observed along the toe of the dam. In particular, investigate whether the seepage at the headwall for the blow-off pipe is related to possible flow along the outside of the pipe. Design and construct remedial measures, as required.

c. Remove trees, stumps, and other vegetation from the upstream and downstream slopes. Fill holes left by tree stumps with appropriate soils. Install slope erosion protection on the downstream slope and stone armor protection on the upstream slope.

d. Consider alternate methods of support of the spillway bridge to reduce the possibility of accumulation of debris in the spillway.

e. Evaluate the present condition of the 18 inch diameter water supply outlet and gates for use as an additional means to rapidly drawdown the pool level. If it is determined that the pipeline condition is too costly to rehabilitate or not needed, then the line should be plugged by grouting the entire length of conduit through the embankment. If the pipeline can be rehabilitated then control gates and blowoff outlets, that return discharges to the natural streambed below the dam, should be included in a periodic maintenance program that will include equipment tests on a regular basis. Control of discharges through this conduit should occur at the intake tower, at the upstream face of the dam.

The Owner should implement any recommendations resulting from the above investigations.

7.3 Remedial Measures

a. Operating and Maintenance Procedures

1. Remove bushes growing on the spillway downstream channel.

2. Institute a program of annual technical inspection by a qualified registered engineer. Inspection should include monitoring of seepage at the toe of the dam.

3. Replace the control handles of the outlet works' gates and perform equipment tests to determine if the outlets are operable. Store the equipment at a convenient location for ready use.

4. Regularly clear vegetation from all slopes and provide a clear area of 20 feet minimum from the toe of the dam to permit access for inspection and monitoring.

5. Develop an "Emergency Action Plan" that will include an effective preplanned warning system, action to be taken at other reservoirs, locations of emegency equipment, material and manpower, authorities to be contacted, potential areas that require warning and/or evacuation and reservoir dewatering procedures. The Owner should also provide surveillance of the dam during intense rainfalls.

6. Repair all spalled and cracked concrete at spillway, headwalls and control tower.

7. Fill in all animal burrows.

8. Replace missing riprap on upstream slope.

7.4 Alternatives

There are no recommended alternates to the recommendations discussed above.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Curran Upper Reservoir Dam DATE November 1, 1979

TIME 8:00 A.M.

WEATHER Clear

W.S.ELEV. 328.0 U.S. _____ D.S.

PARTY :

1. A. Reed, CEM
2. L. Topp, CEM
3. E. Dessert, CEM
4. S. Khanna, CEM
5. G. Castro, GEI
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Curran Upper Reservoir Dam DATE November 1, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	328.0 NGVD
Current Pool Elevation	328.0 NGVD
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	Too irregular to judge
Horizontal Alignment	Too irregular to judge
Condition at Abutment and at Concrete Structures	Minor erosion right of spillway
Trespassing on Slopes	At 2 or 3 locations on downstream slope; in one location erosion channel has developed
Sloughing or Erosion of Slopes or Abutments	None beyond erosion referred to above
Rock Slope Protection - Riprap Failures	Some riprap observed
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	Wet and spongy along most of toe; standing water with rust color downstream of dam
Piping or Boils	None observed
Foundation Drainage Features	None known nor observed
Toe Drains	None known nor observed

PERIODIC INSPECTION CHECK LIST

PROJECT Curran Upper Reservoir Dam DATE November 1, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DAM EMBANKMENT (Cont.)	
Instrumentation System	None known nor observed
Vegetation	Brush, small trees; densely covered

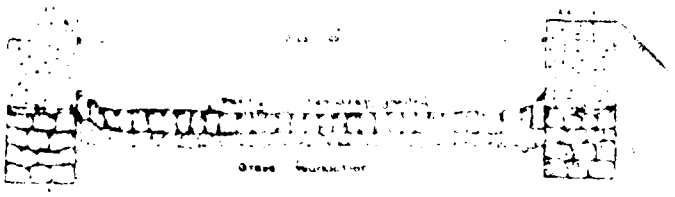
PERIODIC INSPECTION CHECK LIST

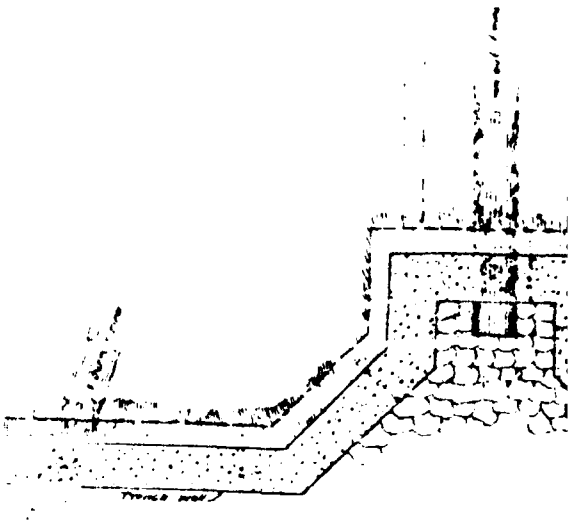
PROJECT Curran Upper Reservoir Dam DATE November 1, 1979

INSPECTOR _____ DISCIPLINE _____

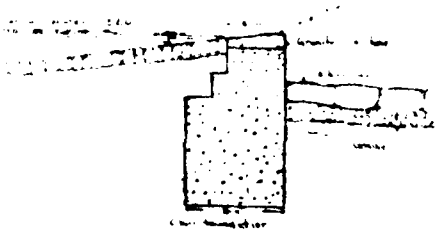
INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Intake tower at upstream toe of dam in reservoir pool; no means of access to inspect. Approach channel to tower intake is natural reservoir bed elevation, Tower controls missing; gatehouse removed; gates appeared to be non-operable.

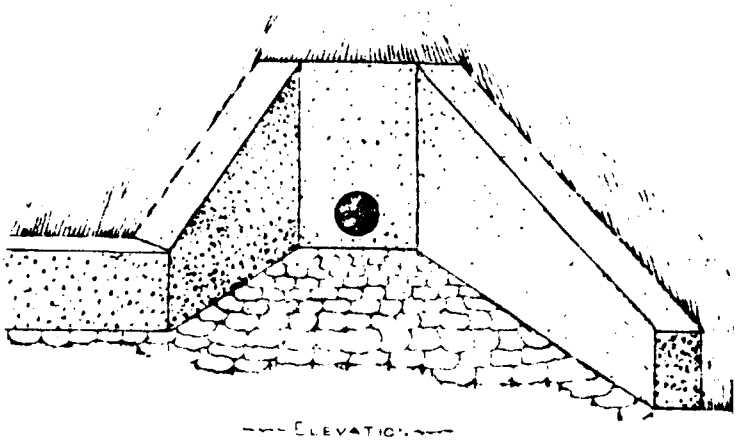




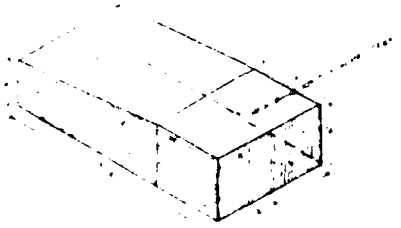
— PLAN —
OF ABUTMENT AT OUT
SCALE 4 FT PER IN



— CROSS SECTION OF SPILLWAY —
SCALE 4 FT PER INCH



— ELEVATION —
OF ABUTMENT AT OUTLET END



— CAP STONE FOR SPILLWAY —
SAME AS ABOVE DRAWING

DETAIL PLA

OF A DAM BUILT FO

PAWTUXET VALLEY

AT FISKEVILLE, R

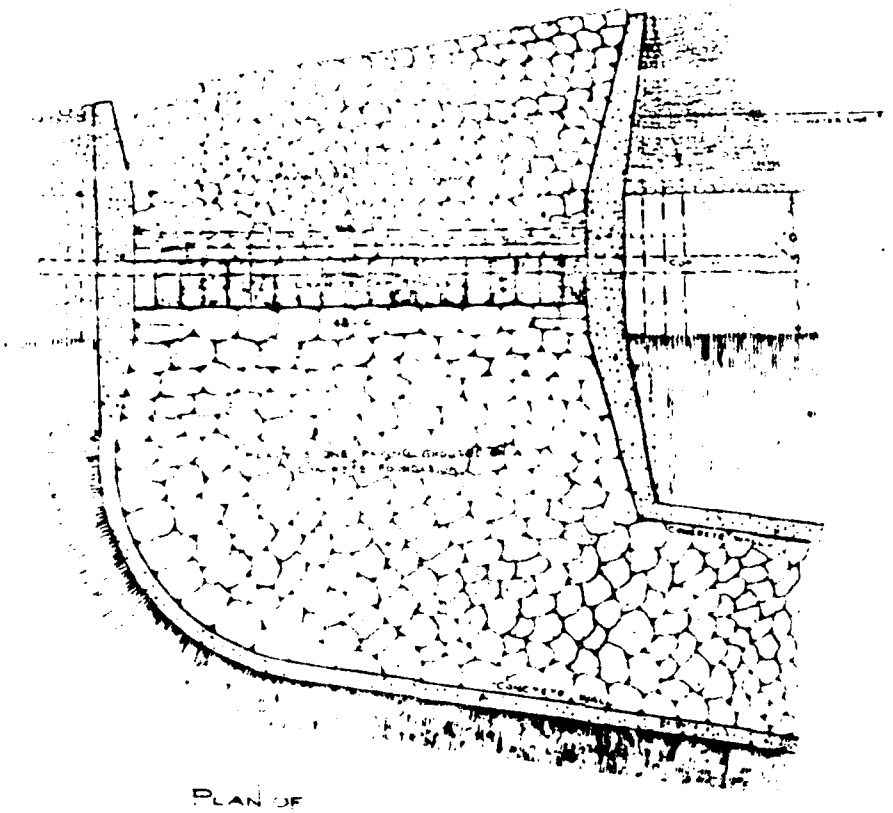
BY J.A. LATHAM, ENGI

— 1902 —

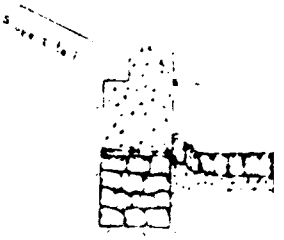
PHOTO REDUCE
NOT TO SCALE

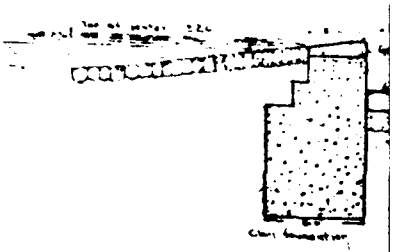
— SHEET NO. —

2 of 3



PLAN OF
— SPILLWAY —
SCALE 8 FEET PER INCH



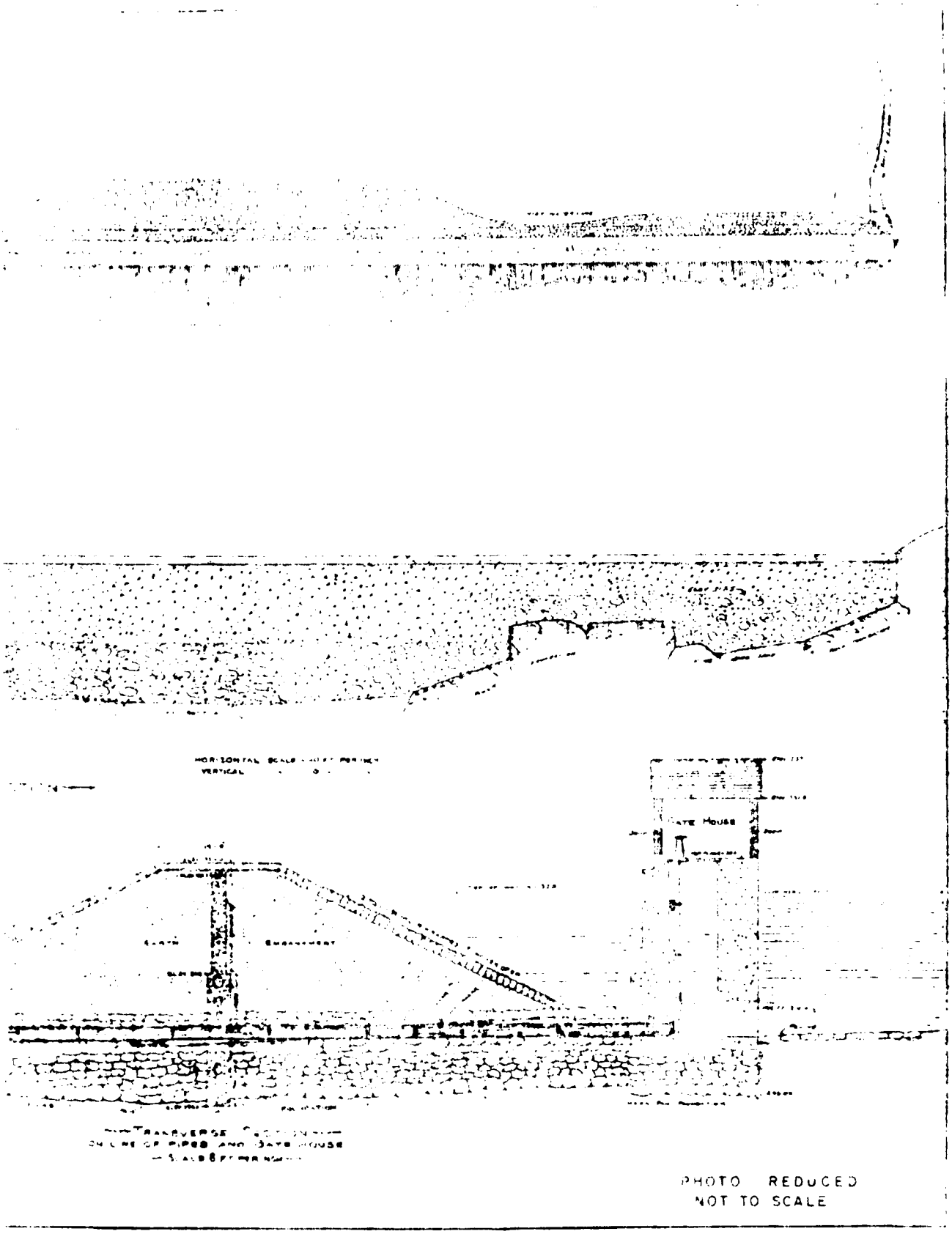


— Cross section at Spi
— Scale 8 ft per inch —

Spillway
of the wall

— Scale: 8 ft per inch —

— SHEET



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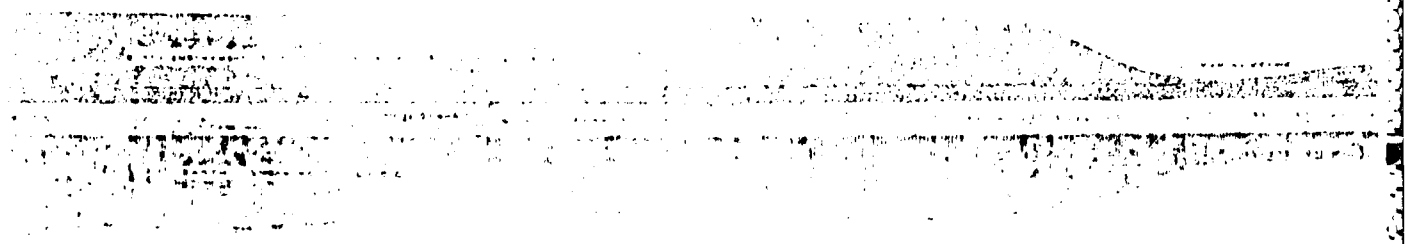
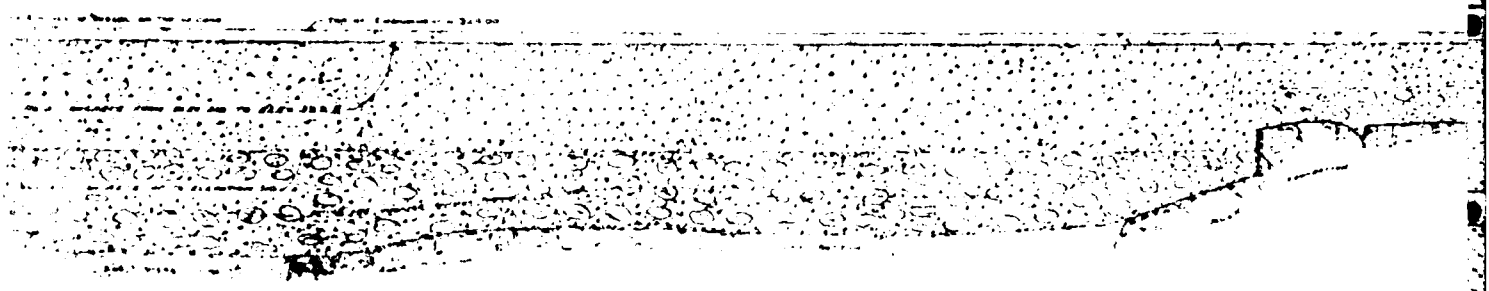
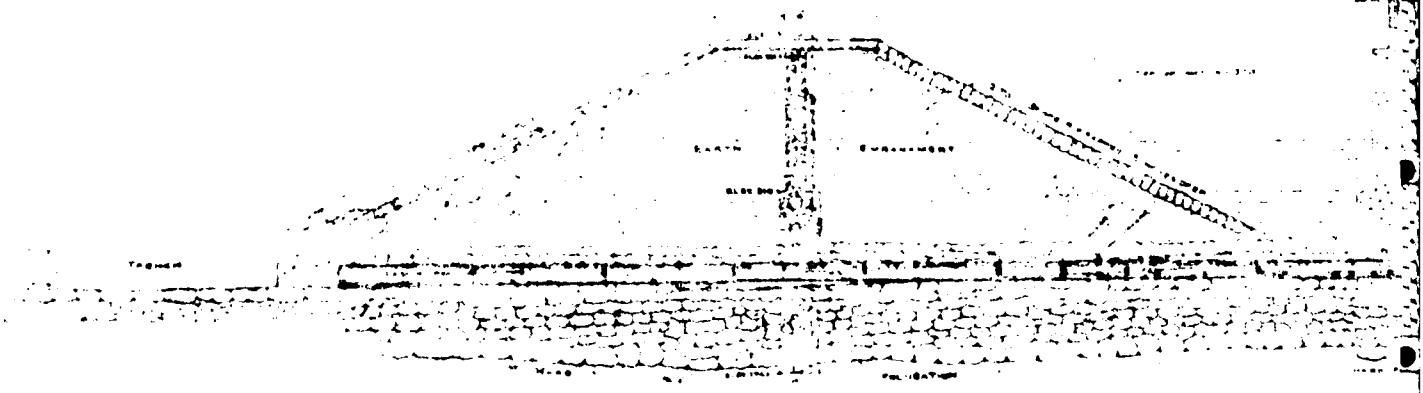
NOT TO SCALE



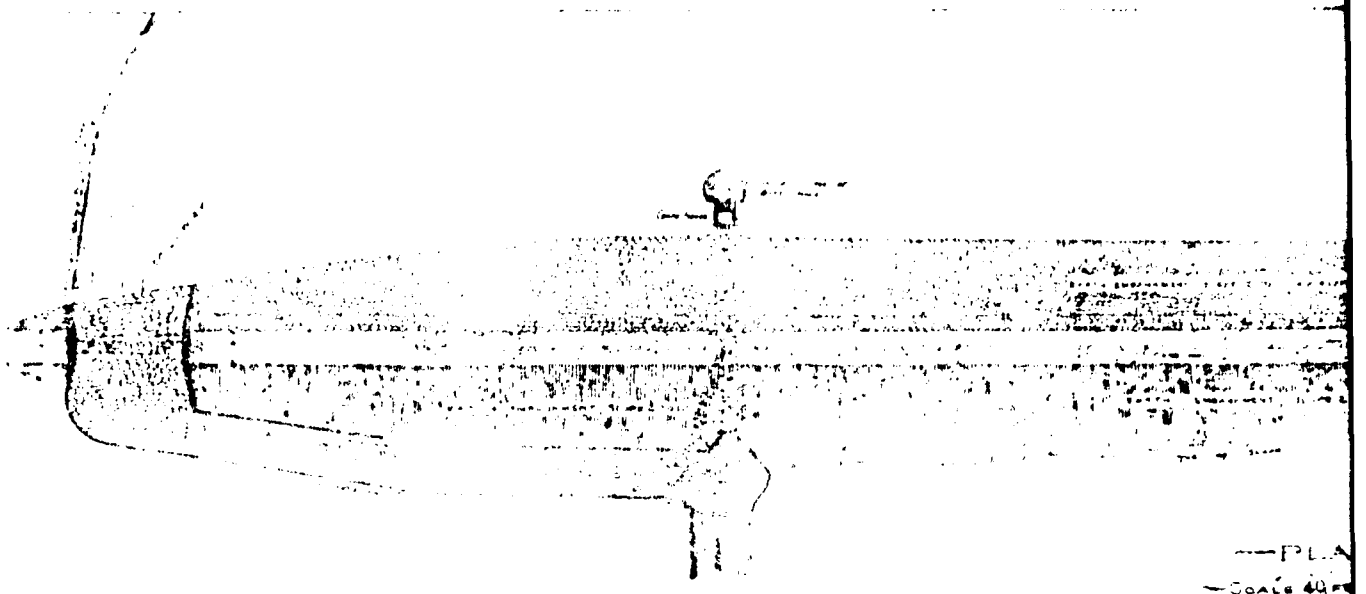
PLAN



LONGITUDINAL SECTION

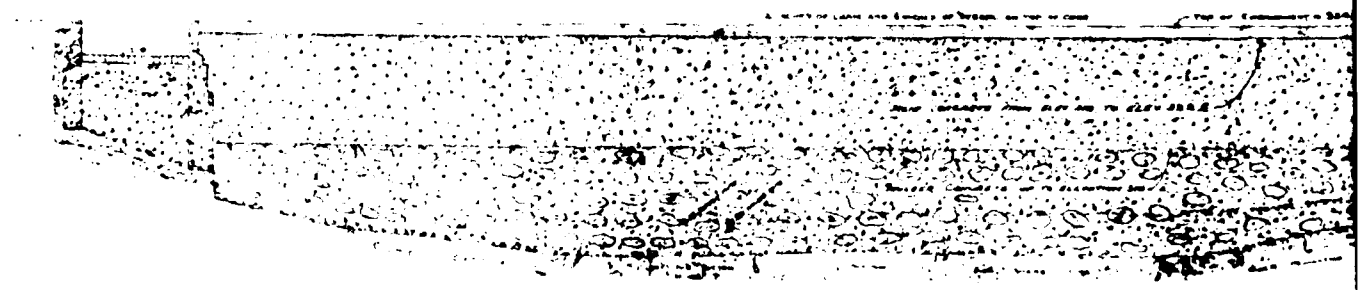


TRANSVERSE SECTION
ON LINE OF PIPES AND GATE HOUSE



—PLA

—Scale 40 F



LONGITUDIN

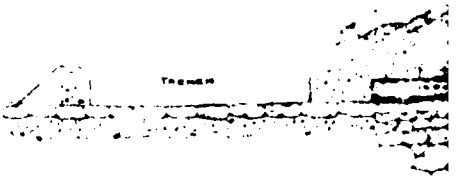
—PLAN—

OF A DAM BUILT ACROSS THE

PAWTUXET VALLEY WATER CO.

AT FISKEVILLE R.I.

—1892—



—SHEET No 1—

10/3

APPENDIX B-3

PLANS, SECTIONS DETAILS

DIVISION OF HARBORS AND RIVERS

SURVEY OF DAMS IN RHODE ISLAND

Pawtuxet River Basin (North Branch) #166 Upper Reservoir

Drainage Area 0.9 sq. mi.

February 1948

Spillway 48' x 4' deep
48' x 32.5 c.f.s. = 1560 c.f.s.*

Estimated extreme freshet 135 c.f.s.

* Capacity of 20" Draw-off pipe with 17' head on center line can be added to this amount.

FEBRUARY 1948

R. I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS & RIVERS

OFFICIAL INSPECTION REPORT

DATE: 3/25/46

INSPECTED BY: JOHN V. KEILY

DAM No. 166 NAME: PAWTUXET VALLEY WATER Co. RESERVOIR Brook CLARKE BROOK

TOWN OR CITY CRANSTON ON PAWTUXET NORTH BRANCH WATERSHED

OWNER PAWTUXET VALLEY WATER COMPANY ADDRESS: 1072 MAIN STREET, WEST WARWICK. TEL. WARWICK 1022

IN EMERGENCY CALL (1) ARTHUR O. LAVALLEY ADDRESS: 40 PARKER St., WEST WARWICK. TEL. No. 1527 Va 1527

(2) ALBERT LANGLAIS ADDRESS: 35 N. PLEASANT STREET, WEST WARWICK TEL. No. VAL 1341-R

(3) ADDRESS: TEL. No.

SPILLWAY—TYPE EARTH DAM WITH CONCRETE SPILLWAY (GRANITE FACED 48' WIDE)

CONDITION: SLIGHT LEAKS IN FACE; NEEDS POINTING.

DRAW-OFF GATES—NUMBER GATE HOUSE AND DRAW-OFF (20" C. I.)

CONDITION:

TRENCH GATES—NUMBER NONE

CONDITION

EMBANKMENT

CONDITIONS NOT INSPECTED ON — Earth

APPROACHES

EROSION CONCRETE WALLS ON SPILLWAY; CONCRETE SPALLING BADLY; SHOULD HAVE TREATMENT SOON.

BRUSH & TREES

RIP-RAP

R. I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS AND RIVERS

SPECIAL INSPECTION REPORT

DAM NO. 166

INSPECTED BY J. V. KEILY

TOWN - CRANSTON | BROOK CLARKE BROOK

DAM NO 156 NAME P. V. WATER CO. RES. #2 ON [redacted]

WATERSHED PAWTUXET N B

OWNER PAWTUXET VALLEY WATER COMPANY | [redacted]

ADDRESS 1072 MAIN STREET, WEST WARWICK, TEL. VAL. 0102

REPORT ON—NEW CONSTRUCTION REPAIRS INSPECTION ONLY X

PLANS BY APPROVED CONTRACTOR

TICKLER

SPILLWAY
TYPE
CONDITION

DRAW-OFF GATES
NUMBER
CONDITION

TRENCHES & WHEELS

EMBANKMENT
TYPE
CONDITION
APPROACHES
EROSION
BRUSHES & TREES
RIPRAP

PRESENT USE

WHO CONTROLS

WHO CONTACTED AT SITE

INSTRUCTIONS LEFT

IN EMERGENCY CALL

INSPECTION REPORT BY JOHN V. KEILY REASON ROUTINE DATE 3/25/46

EMERGENCY:

1. ARTHUR O. LEVALLEY, Mgr., 40 PARKER STREET, WEST WARWICK, TEL. VAL. 1527
2. ALBERT LANGLAIS, 35 MOUNT PLEASANT AVE., WEST WARWICK, TEL. VAL. 1341-R
3.

3/25/46 condition - good

LONG EARTH DAM WITH CONCRETE CORE, BUILT 1902-3, TO RETAIN 200,000,000 GALS. OF WATER FOR PAWTUXET VALLEY WATER COMPANY. WELL BUILT EARTH DAM WITH FULL RIPRAPPED SLOPE ON POND SIDE AND GRASSED SLOPES ON TOP AND DOWN-STREAM FACE. MAXIMUM HEIGHT 23 FEET. 48-FOOT GRANITE SPILLWAY AT WEST END OF EMBANKMENT WITH 4' CONCRETE ABUTMENTS above CREST OF DAM. DAM IN GENERALLY GOOD CONDITION; SLIGHT LEAKS ON FACE OF SPILLWAY WILL NEED POINTING SOON. CONCRETE WALLS BELOW SPILLWAY ARE SPALLING BADLY; SHOULD HAVE TREATMENT SOON. HEIGHT OF POND IS CONTROLLED BY PAWTUXET VALLEY WATER COMPANY; READINGS TAKEN EVERY DAY 7-8 A. M.

DETAILS: DRAINAGE AREA APPROX. 1 SQUARE MILE; SURFACE AREA APPROX. 32 ACRES; CAPACITY 200,000,000 GALS. PLUS.

USE OF THIS UPPER RESERVOIR IS TO BE DISCONTINUED (EXCEPT FOR EMERGENCY USE) ABOUT AUGUST, 1946, DUE TO POLLUTION OF WATER FROM NEARBY FARMS. BETTER WATER WILL BE OBTAINED FROM WELLS AT WASHINGTON, R. I., AND FROM CARR POND IN WEST GREENWICH (#194). SEE NEXT REPORT.

APPENDIX B-2

Selected Copies of Past Inspection Reports

APPENDIX B-1

Correspondence pertaining to the history, maintenance, and modifications to the Curran Upper Reservoir Dam as wall as copies of past inspection reports are located at:

Department of Environmental Management
State of Rhode Island
83 Park Street
Providence, Rhode Island 02903

APPENDIX B

ENGINEERING DATA

PERIODIC INSPECTION CHECK LIST

PROJECT Curran Upper Reservoir Dam DATE November 1, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Straight approach channel through reservoir
General Condition	Poor
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Natural reservoir bed
b. Weir and Training Walls	
General Condition of Concrete	Poor, badly spalled
Rust or Staining	At some locations
Spalling	Extensive
Any Visible Reinforcing	None
Any Seepage or Efflorescence	Below weir crest and through training walls
Drain Holes	None observed
c. Discharge Channel	
General Condition	Poor, walls have spalled severely; seepage under left wall
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	A few
Floor of Channel	Paved with stone
Other Obstructions	Brush and grass growing

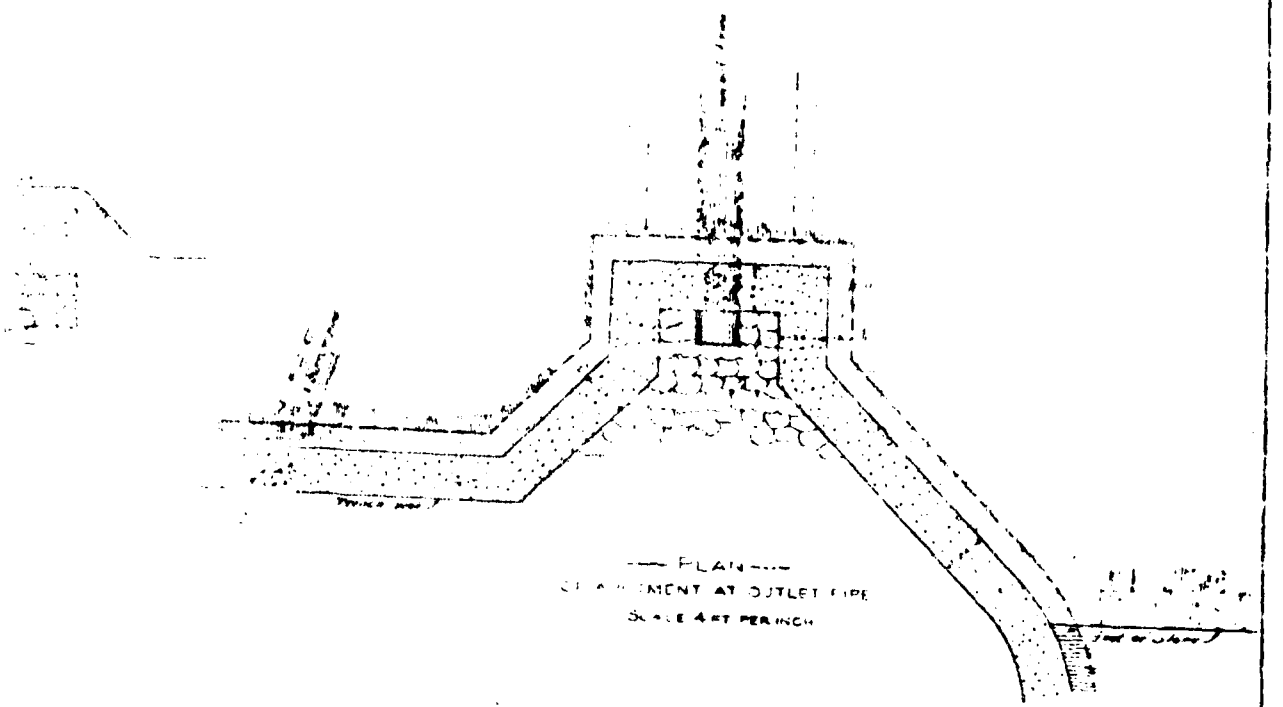
PERIODIC INSPECTION CHECK LIST

PROJECT Curran Upper Reservoir Dam DATE November 1, 1979

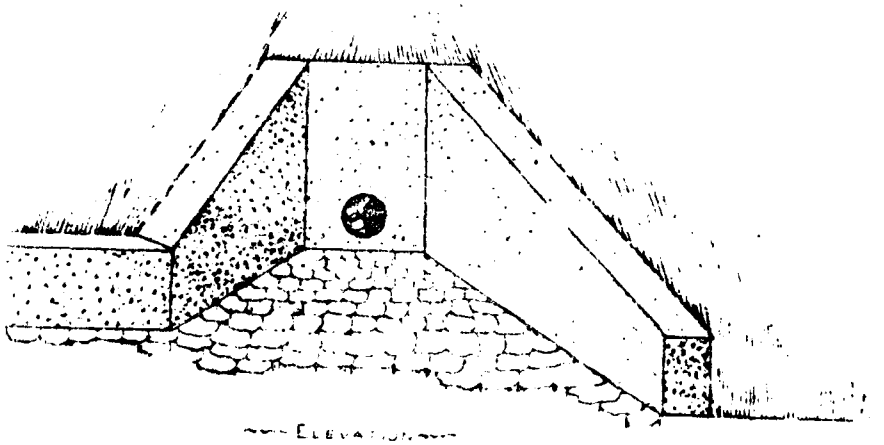
INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Heavy vegetation and spalling of concrete at headwall structure
Rust or Staining	Rust stained standing water in many locations
Erosion or Cavitation	None observed
Visible Reinforcing	None observed
Any Seepage or Efflorescence	Seepage noted at outlet headwall
Condition at Joints	Fair
Drain Holes	None observed
Channel	Debris and vegetation
Loose Rock or Trees Overhanging Channel	Many trees
Condition of Discharge Channel	Poor, due to debris
	Seepage at spalled base of headwall



PLAN
OF ABUTMENT AT OUTLET PIPE
SCALE 4 FT PER INCH



ELEVATION
OF ABUTMENT & OUTLET PIPE

DETAIL PLAN

OF A DAM BUILT FOR THE

PAWTUXET VALLEY WATER CO.

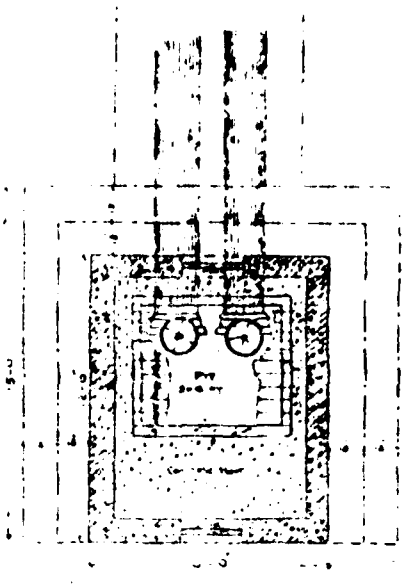
AT FISKEVILLE, RI

BY J.A. LATHAM, ENGR

1902

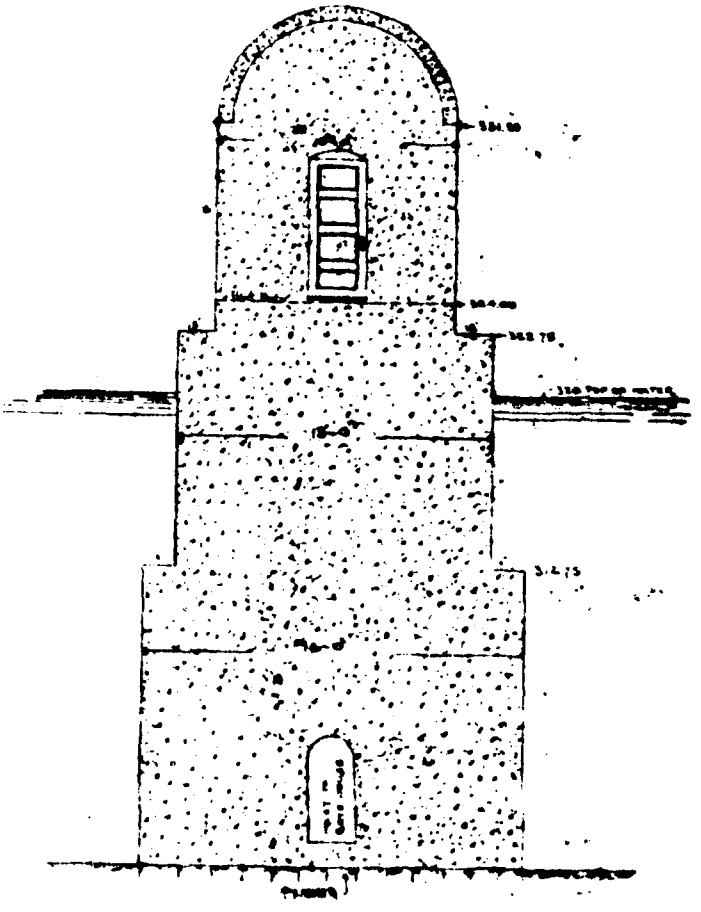
PHOTO REDUCED
NOT TO SCALE

3 of 3



— PLAN —
OF GATE HOUSE.

PAW



— NORTH ELEVATION OF GATE HOUSE —

1 of 2

GATE HOUSE

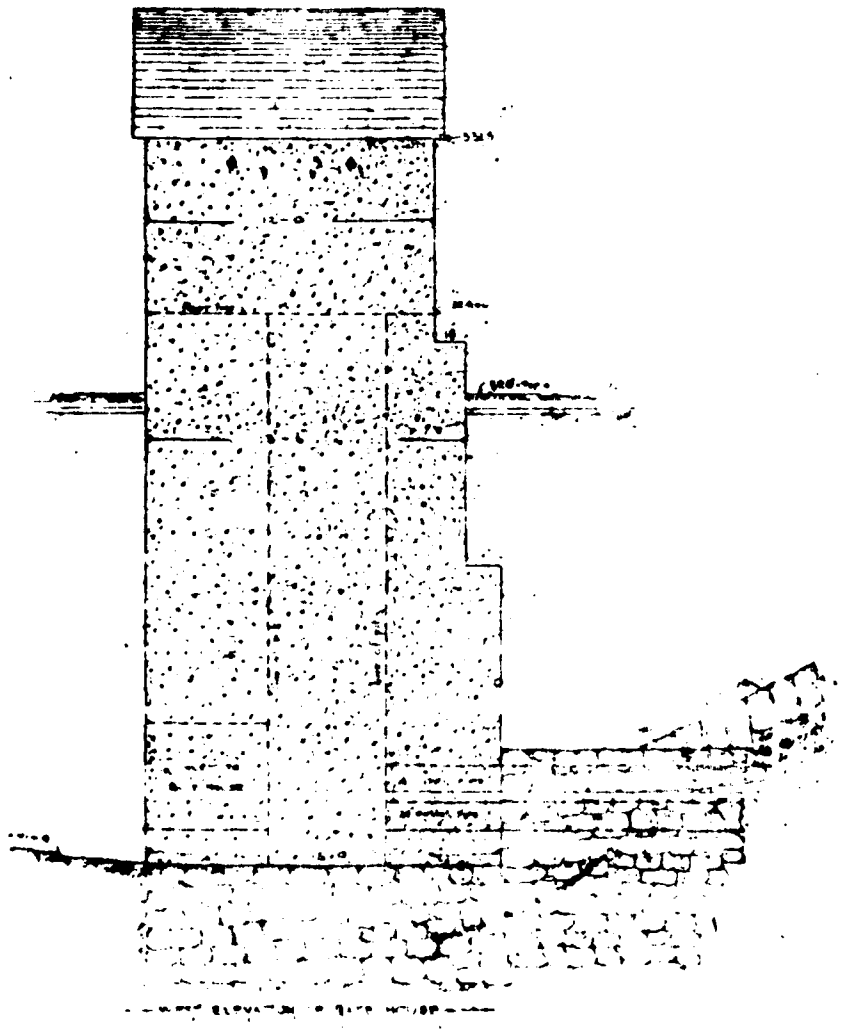
AT DAM BUILT FOR THE

PAWTUXET VALLEY WATER CO.

AT FISKEVILLE, R. I.

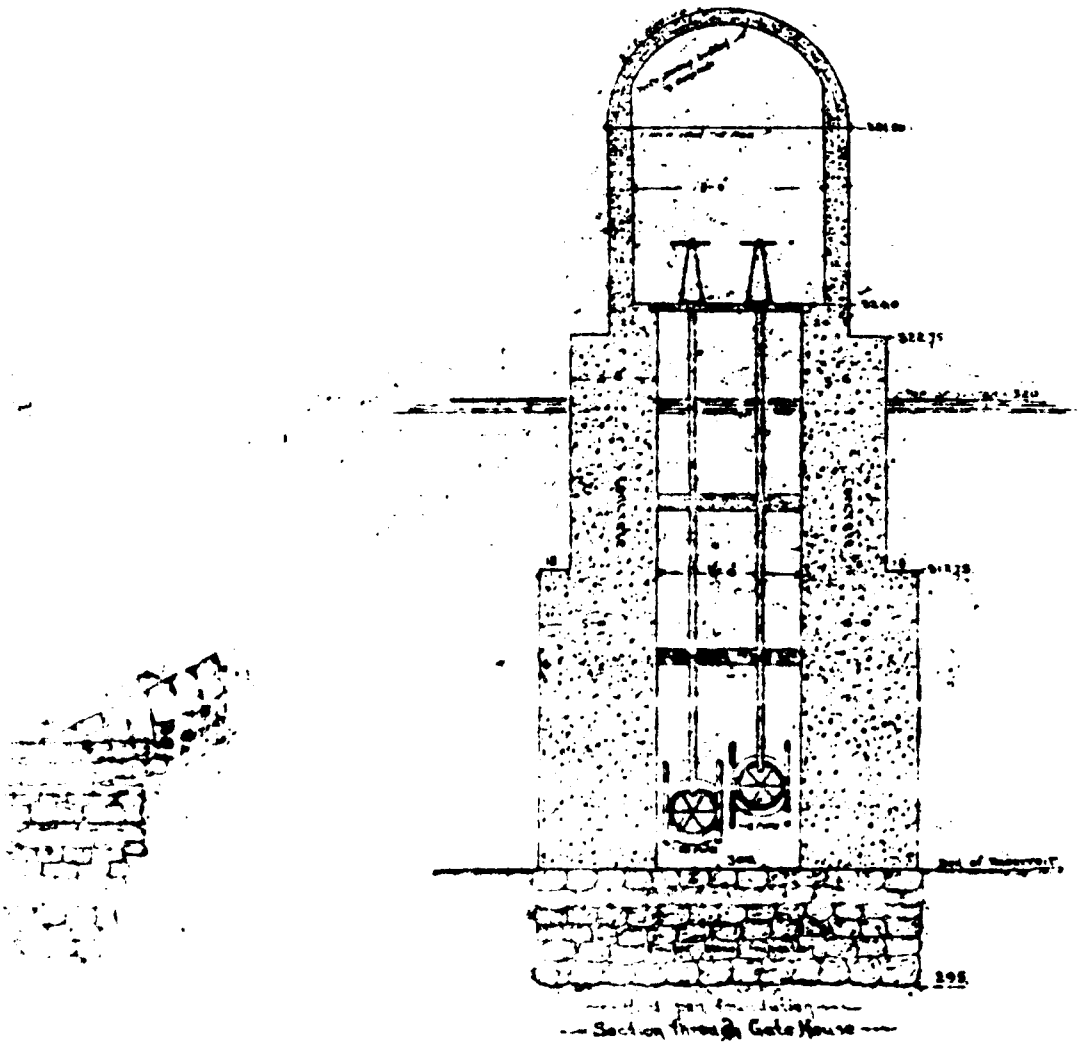
BY J. A. LATHAM, ENGR.

— 1902 —



— SHEET NO 3 —

WATER CO.



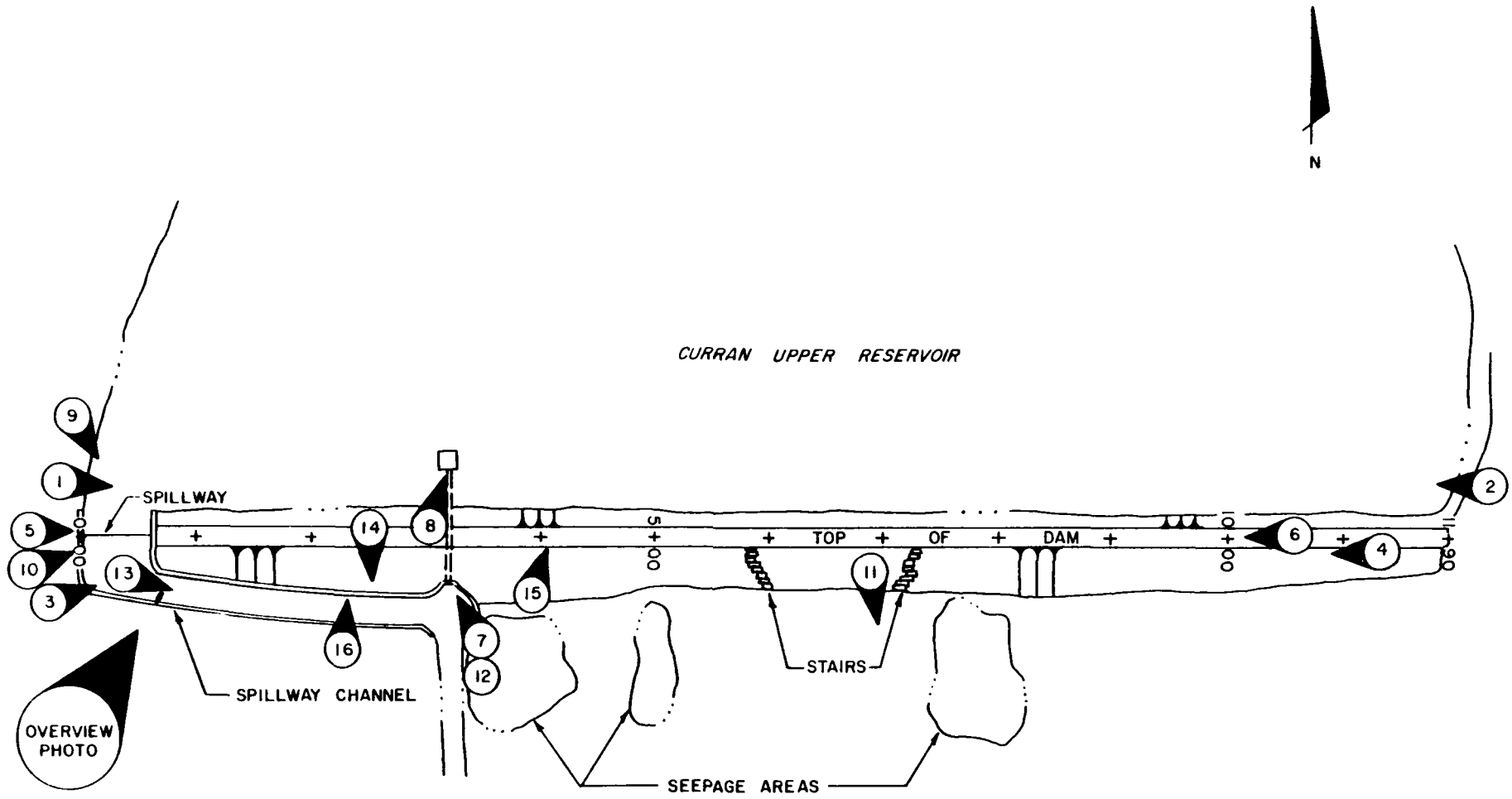
— Section through Gate House —

PHOTO REDUCED
NOT TO SCALE

343

APPENDIX C

PHOTOGRAPHS



CURRAN UPPER RESERVOIR DAM
PHOTO INDEX

PHOTO C-1 Upstream face of dam looking from right abutment

PHOTO C-2 Upstream face of dam

PHOTO C-3 Downstream slope of dam taken from right abutment

PHOTO C-4 Downstream slope of dam taken from left abutment

PHOTO C-5 Crest of dam looking from spillway

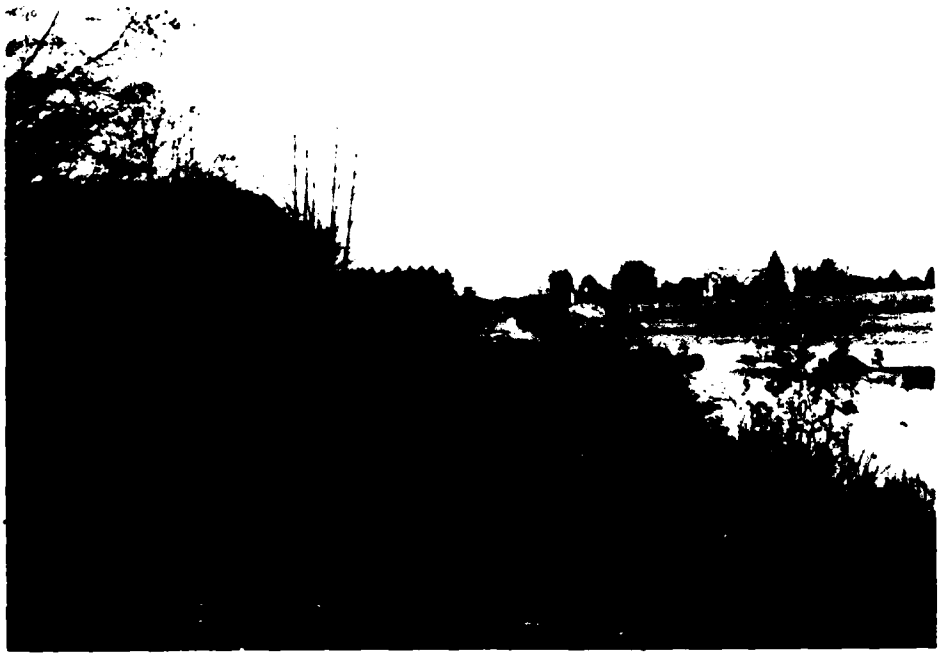


PHOTO C-6 Crest of dam looking from right abutment

PHOTO C-7
Outlet works conduit at downstream toe of dam

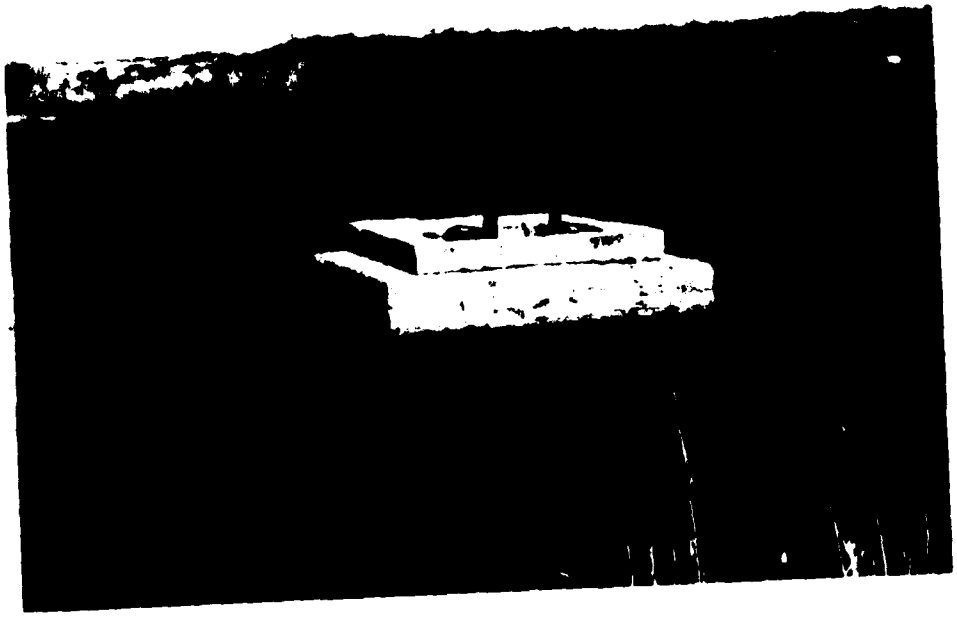


PHOTO C-8 Outlet works gate control mechanism

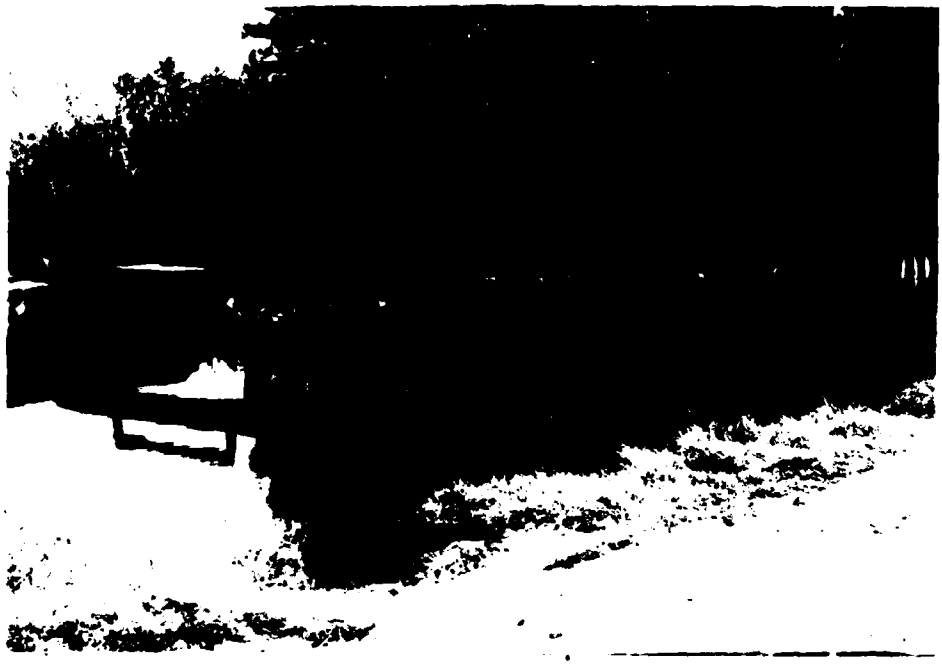


PHOTO C-9 Spillway looking downstream

PHOTO C-10 Spillway looking upstream at left training wall

PHOTO C-11 Seepage at downstream toe of dam

PHOTO C-12 Seepage through headwall of outlet conduit at downstream toe of dam

PHOTO C-13 Downstream spillway channel along toe of dam

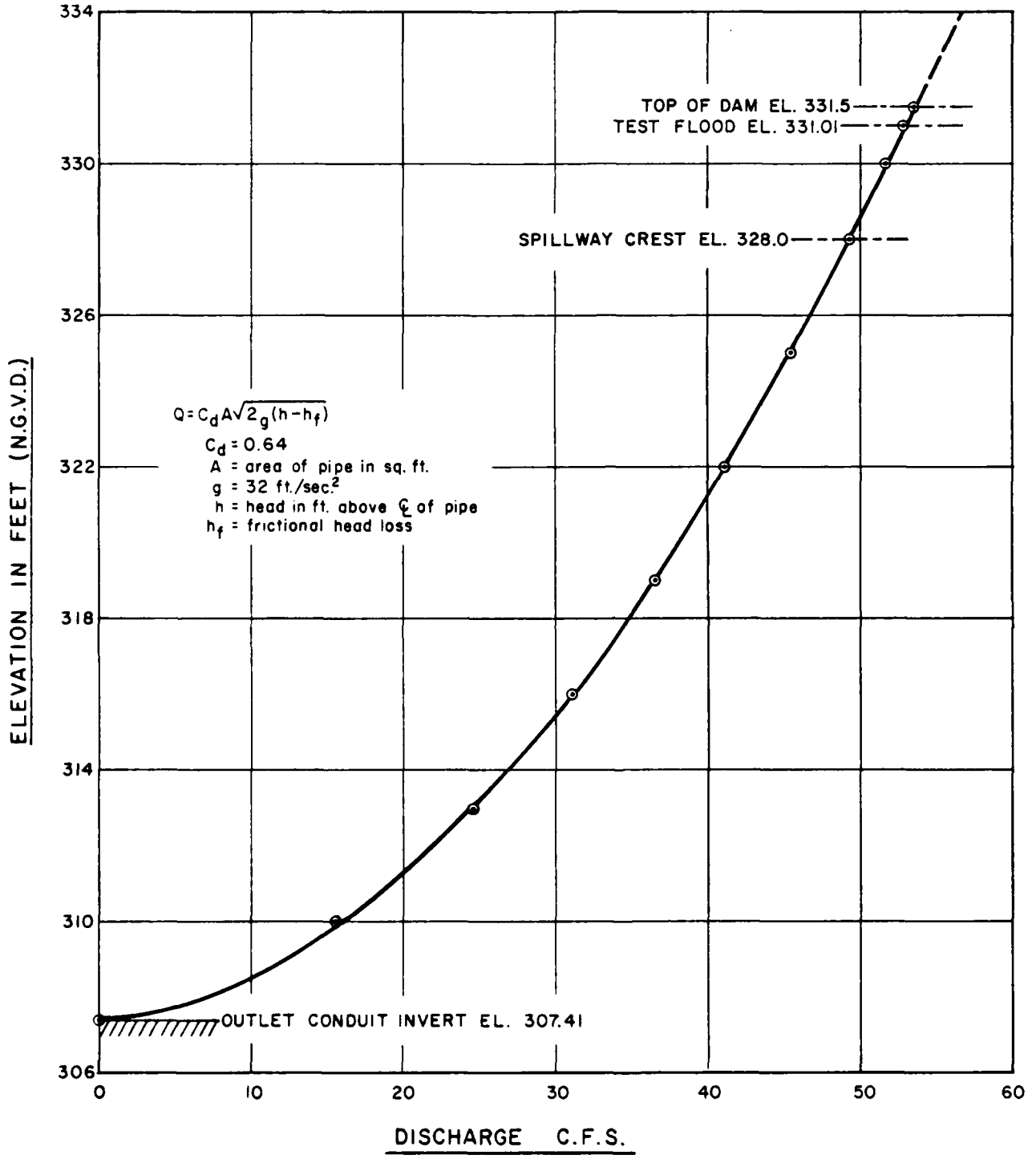
PHOTO C-14 Erosion on downstream slope from trespass

PHOTO C-15 Animal hole on downstream slope embankment

PHOTO C-16 Deteriorated concrete on spillway channel training wall

APPENDIX E

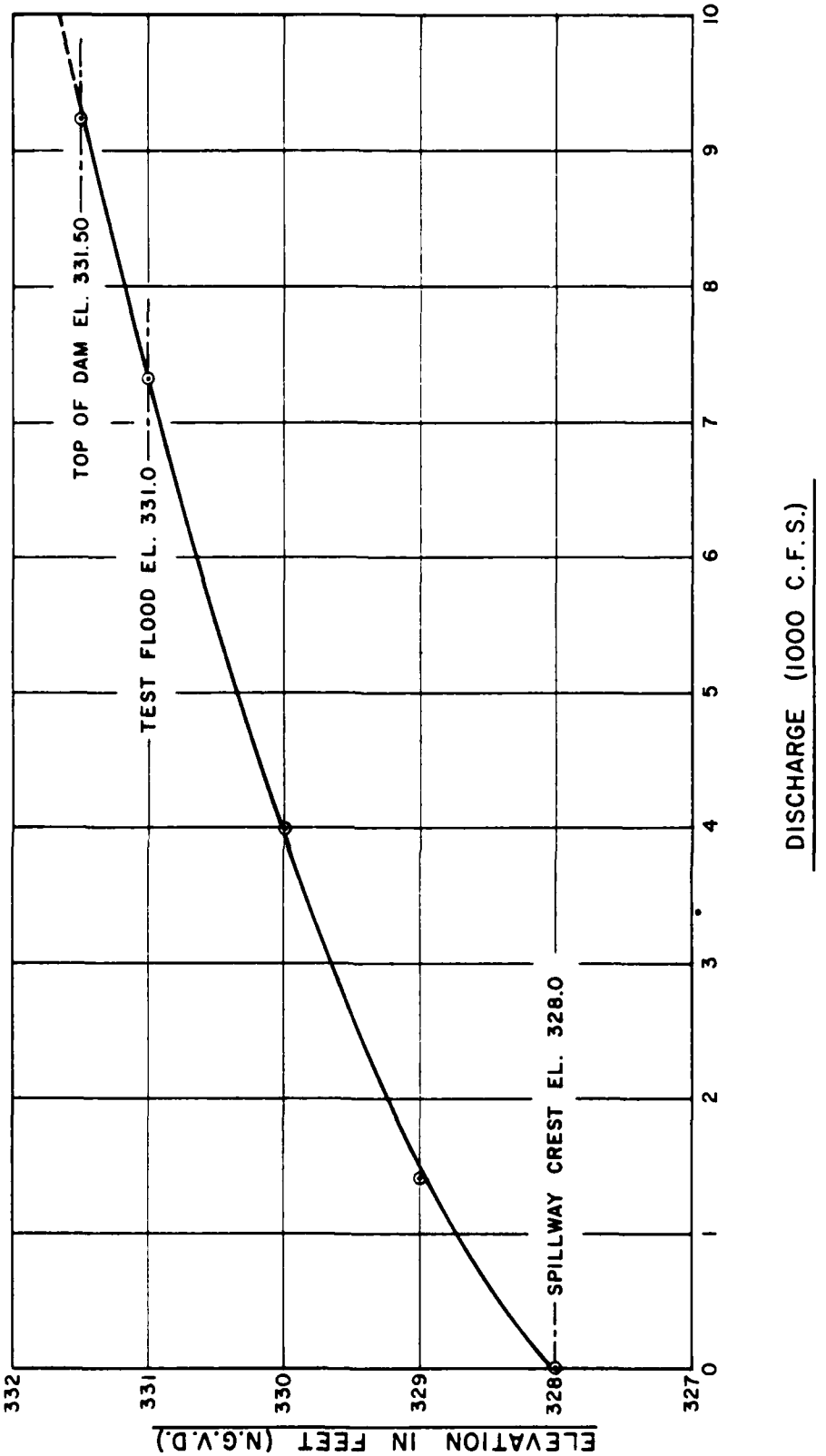
INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS



OUTLET RATING CURVE

CURRAN UPPER RESERVOIR DAM

PLATE D-12



SPILLWAY RATING CURVE

CURRAN UPPER RESERVOIR DAM

PLATE D-11

Curran Upper Reservoir Dam

COMPUTATIONS FOR
SPILLWAY RATING CURVE AND
OUTLET RATING CURVE COMPUTATIONS

Spillway width = 47.0 feet; Spillway crest elevation = 328.0 NGVD

Length of dam = 1200 feet; Top of dam elevation = 331.5 NGVD

C = 3.0

i) SPILLWAY RATING CURVE COMPUTATIONS

Elevation (ft.) NGVD	Spillway Discharge (CFS)	Remarks
328.0	0	Spillway Crest
329.0	141	
330.0	399	
331.0	732	Test Flood Level
331.5	923	Top of Dam

ii) OUTLET RATING CURVE COMPUTATIONS

Elevation (ft.) NGVD	Discharge (CFS)	Remarks
331.5	53.3	Top of Dam
331.01	52.75	Test Flood Level
330.0	51.6	
328.0	49.2	Spillway Crest
325.0	45.3	
322.0	41.1	
319.0	36.5	
316.0	31.1	
313.0	24.6	
310.0	15.6	
307.41	0	Invert of Outlet

Size of outlet = 20"diameter pipe ; Area of outlet = 2.17 sq. ft.

Invert of outlet = 307.41 NGVD ; Center line of outlet = 308.24 NGVD

DAM FAILURE ANALYSIS

STEP 5 -

Anticipated adopted minimum wave depth of flow = $d_{minimum}$
= 0.17 y_o feet = 4.60 feet

Parabolic shaped water surface profile from the dam upto obstruction presumably unwashable Curran Lower Reservoir Dam 2000 ft. (x_{total}) ft. downstream is computed by and adjusted for possible steady and normal flow depth backup in the below given table.

$$(\tfrac{4}{9} y_o - d_{min.}) \left(\frac{x}{x_{total}}\right)^2 = 0.28\, y_o \left(\frac{x}{x_{total}}\right)^2 \text{ where } x_{total} = 2000 \text{ ft.}$$

Distance from center line of dam = x	$(\frac{x}{x_{total}})^2$	Drop in depth	Water Surface Elevation as Unsteady Flow	Ground Elevation	Normal Depth	Adopted Water Surface Elevation
0	0	0	331.5 = Top of dam	--		331.5 =Top of dam
0	0	$\frac{5}{9} y_o$ = 15.0ft.	316.5		d_n	316.5 = just D/S of dam
100	0.002	0.015	316.49	304.5	12.0	316.5
300	0.018	0.14	314.36	302.5	12.0	314.5
500	0.050	0.38	312.12	300.5	12.0	312.5
700	0.098	0.74	309.76	298.5	11.5	310.0
900	0.162	1.22	307.28	296.5	11.5	308.0
1100	0.242	1.83	304.67	294.5	11.5	306.0
1300	0.338	2.55	301.95	292.5	11.0	303.5
1500	0.450	3.40	299.10	290.5	11.0	301.5
1700	0.578	4.37	296.13	288.5	11.0	299.5
1900	0.772	5.82	292.68	286.5	11.0	297.5
2100	0.882	6.67	289.83	284.5	10.8	295.3
2200	1.000	7.56	286.94	282.5	10.8	293.3

Note: Adopted water surface elevation is higher of the two values:

a) Ground Elevation + $\frac{4}{9} y_o$ = drop in depth

OR b) Ground Elevation + d_n

DAM FAILURE ANALYSIS

NOTES:

1. $W_B \leq B$
2. Failure of dam is assumed to be instantaneous when pool reaches top of dam, and is a full depth - partial width rectangular shaped failure.

STEP 1 - Dam Failure Discharge = Q_b

$$Q_b = \frac{8}{27} W_B \sqrt{g}\, y_o^{3/2} \left(\frac{B}{W_B}\right)^{0.25*} = 1.68\, B^{0.25}\, W_B^{0.75}\, y_o^{1.5}$$

$$= 12963 \text{ C.F.S.}$$

* Reference: Research note No. 5, "Guidelines for Calculating and Routing a Dam - Break Flood by the Hydrologic Engineering Center - C.O.E. - January, 1977.

Maximum Spillway Discharge = Q_S = 923 C.F.S.

(C = 3.0 B = 47.0 H = 3.5 ft.)

STEP 2 - Wave Flow (Unsteady Flow) Characteristics

Depth of flow immediately downstream of Dam = $\frac{4}{9} y_o$ = 12.0 ft.

Velocity of flow immediately downstream of Dam = $\frac{2}{3} \sqrt{g y_o}$

= 19.63 ft./sec.

STEP 3 - Adopted minimum possible depth of flow = 0.138 y_o = 3.73 ft.

Actual maximum possible velocity of flow = $2 \sqrt{g y_o}$ = 58.97 ft./sec.

Adopted theoretical maximum possible velocity = $\frac{2}{3}\ 2 \sqrt{g y_o}$ = 39.2 ft./sec.

STEP 4 - Normal Flow (typical) Manning's Characteristics

Location of unwashable major obstruction Curran Lower Reservoir

2000 = ft. D/S

S_o = 0.01 ; "n" = 0.055 ; Bed width of channel = b = varies

Total failure discharge = $Q = Q_b + Q_S$ = 13896 C.F.S.

Normal depth of flow for Q (13886 C.F.S.) = 12.0 feet = d_n

Normal depth of flow for Q (923 C.F.S.) = 3.0 feet = d_n^1

Adopted maximum depth is larger of $\frac{4}{9} y_o$ or d_n = 12.0 feet

Adopted increase in depth due to failure of dam ($\frac{4}{9} y_o$ or d_n) - d_n^1 = 9.0 feet

Adopted maximum velocity of flow = $\frac{4}{3} \sqrt{g y_o}$ = 39.2 ft./sec.

DAM FAILURE ANALYSIS

In addition to energy considerations, the volume of water which is available in the reservoir to sustain the flood wave must be considered. Important energy losses which occur as the flood wave moves downstream include friction losses, bend losses, obstruction losses, expansion and contraction losses, etc. Also the failure discharge and energy losses are reduced by the failure hydrograph being modified with decreasing peak due to available storages downstream. Judgment was used to estimate the most critical situation after the dam failure. Consequently analysis was based upon i) undular wave rather than hydraulic bore; ii) impact of flood wave and the resulting energy loss due to damaged or destroyed structures and sinuosity of the channel were ignored; and iii) the dam failure discharge of 12960 C.F.S. will merge with 923 C.F.S. already flowing through the existing overflow spillway making a total outflow of 13890 C.F.S. It is assumed that prior to failure, the maximum spillway discharge has already substantially filled the available storage areas downstream. In this case large storage areas are not available and no adjustment of outflow discharge is required. At a distance of 2000 feet downstream the Curran Lower Reservoir _____ obstruction will not allow this large discharge to go through and ponding against this obstruction will convert its wave and kinetic energy back into pressure energy and flow changing to steady and uniform flow with 10.8ft depth following Manning's formula.

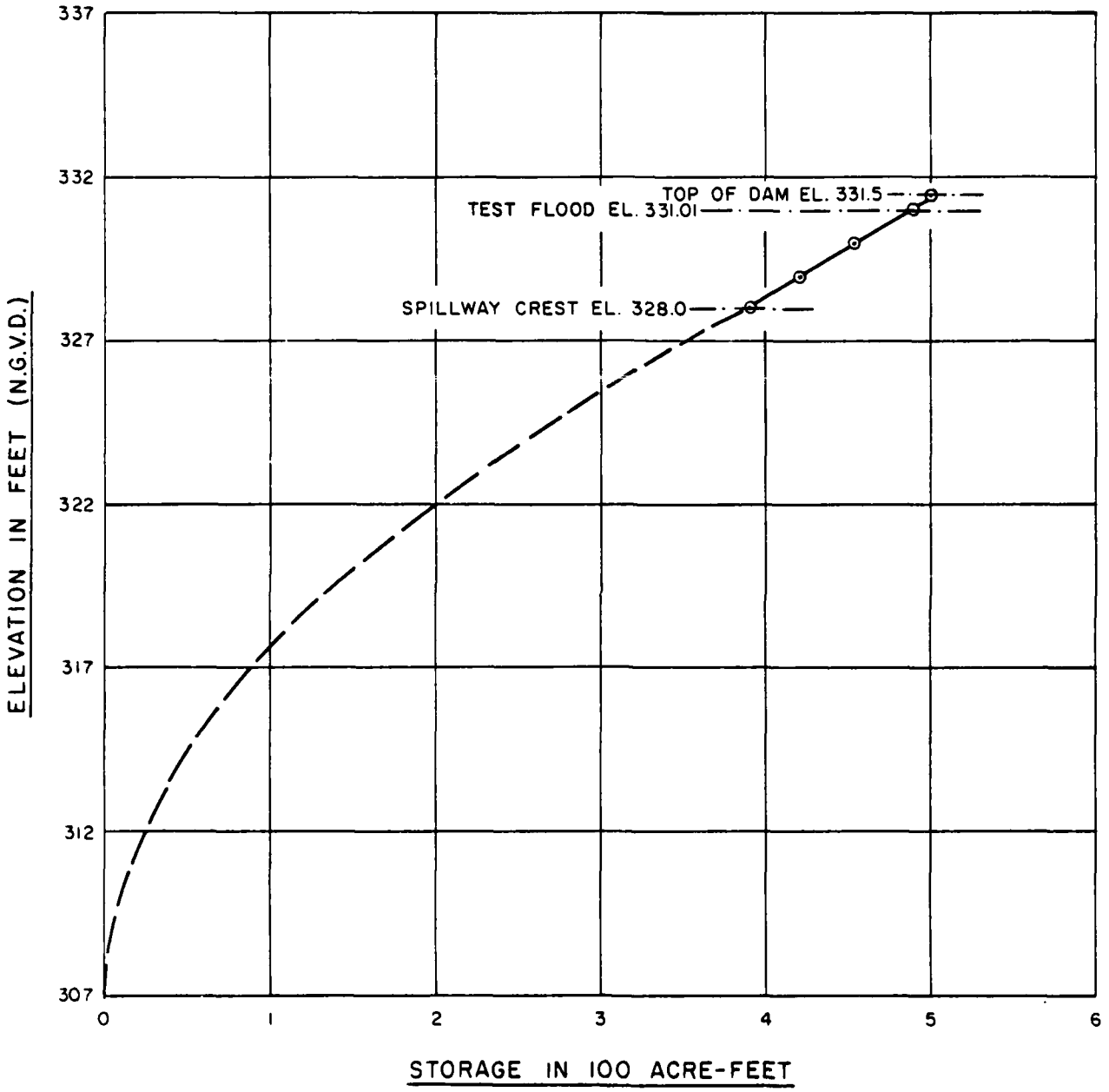
NOTE: --

1. Adopted water surface elevation is higher of the two values:
   a) ground elevation + $\frac{4}{9} y_o$ - drop in depth

   OR b) ground elevation + d_n
2. There are three depths for different characteristics of flow.
   a) Depth of flow immediately downstream of dam for unsteady flow conditions = $\frac{4}{9} y_o$ = 12.0 feet
   b) Normal depth for $Q = Q_{b_1} + Q_S$ value of discharge = d_n = 12.0 feet
   c) Normal depth for $Q_S = d_n^1$ = 3.0 feet
3. Maximum depth is greater of $\frac{4}{9} y_o$ or d_n = 12.0 feet

   Maximum velocity of flow = $\frac{4}{3}\sqrt{gy_o}$ = 39.2 ft./sec.

   Increase in depth due to failure = (d_n or $\frac{4}{9} y_o$) - $d^1 n$ = 9.0 feet



STORAGE-ELEVATION CURVE

CURRAN UPPER RESERVOIR DAM

PLATE D-6

Curran Upper Reservoir Dam

"Rule of Thumb Guidance for Estimating Downstream Dam Failure Discharge"

BASIC DATA

Name of dam Curran Upper Reservoir Dam Name of town Cranston, R.I.

Drainage area = 0.93 sq. mi., Top of dam 331.50 NGVD

Spillway type = overflow; free vertical fall Crest of spillway 328.0 NGVD

Surface area at crest elevation = 32.0 acres = 0.05 sq. mi.

Reservoir bottom near dam = 304.50 NGVD

Assumed side slopes of embankments 2:1

Depth of reservoir at dam site 27.0 = y_o = 27.0 ft.

Mid-height elevation of dam = 318.0 NGVD

Length of dam at crest = 1190 ft.

Length of dam at mid-height = 1100 ft.

5% of dam length at mid-height = W_b = 55 ft.

Width of channel immediately downstream = B = 55 ft.; Shape of Breach = rectangular

Elevation (NGVD)	Estimated Storage in AC-FT	
328.0	390	Spillway Crest
329.0	421	
330.0	453	
331.01	490	Test Flood
331.5	500	Top of Dam

Name of Dam: Curran Upper Reservoir Dam

Estimating Effect of Surcharge Storage on "Test Flood"
[Routing of Flood Through Reservoir]

The routing of floods through the reservoir was carried out according to guidelines established by the Corps of Engineers in Phase-1 Dam Safety Investigations issued March, 1978.

Formulae used were the following for peak inflow = Q_{p1} in C.F.S.

Surcharge height to pass Q_{p1} in feet = $h_1 = \left[\frac{Q_{p1}}{CB}\right]^{2/3}$ ----------(1)

Surcharge storage in inches for surcharge height h_1 = $S_1 = \frac{S.A \times h_1 \times 12}{D.A}$ ---(2)
where S.A = surface area in square miles
where D.A = drainage area in square miles

$$Q_{p2} = Q_{p1}\left[1 - \frac{S_1}{\text{Total Effective Rainfall}}\right] \text{----------(3)}$$

First Approximation

Test flood inflow = Half PMF = Q_{p1} = 930 C.F.S.

h_1 = 3.51 feet

S_1 = 2.26 inches

Final Approximation

Test flood outflow = Q_{pfinal} = 740 C.F.S.

h_{final} = 3.01 feet

S_{final} = 1.94 inches

In this final approximation, equations (1), (2) and (3) are satisfied by trial and error with total effective rainfall equal to 9.5 inches.

Estimating Maximum Probable Discharges - Inflow and Outflow Values Date of Inspection: November 1, 1979

Name of Dam Curran Upper Reservoir Dam ; Location of Dam Clarke Brook ; Town Cranston, R.I.

Watershed Characterization Rural, agricultural with rolling terrain ; _ sq. miles of drainage area is swampy or occupied by storage reservoirs

Adopted "test" flood = Half PMF = 1000 CSM = 930 CFS; Re = Effective Rainfall = 9.5 inches

D.A. = Drainage Area (Gross) = 0.93 Square Miles; Basin Slope = 0.02+ hence; steep

S.A. = Surface Area of Reservoir = 0.05 Square Miles; Time of Concentration 30 minutes

Shape and Type of Spillway = Free vertical overfall, concrete and stone face

B = Width of Spillway = 47.0 feet; C = Coefficient of Discharge = (3.10-Friction) = 3.0

Maximum Capacity of Spillway Without Overtopping = 923 CFS = 100 % of test flood

Top of Dam Elevation = 331.5 ; Spillway Crest Elevation = 328.0

Overflow portion of Length of Dam = 1190 ; C = Coefficient of discharge for Dam = 3.0

Name of Dam	Test Flood Q_p		Inflow Characteristics		Outflow Characteristics First Approximation			Outflow Characteristics Second Approximation			Outflow Characteristics Third Approximation (Adopted)		
	CSM	CFS	h_0 in feet	S_0 in in.	Q_{p1} CFS	h_1 in ft.	S_1 in in.	S_2 in in.	h_2 in ft.	Q_{p2} CFS	S_3 in in.	h_3 in ft.	Q_{p3} CFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	100 year PMF =500	465	2.21	1.43	-	-	-	-	-	-	1.17	1.82	346
	½PMF =1000	930	3.51	2.26	-	-	-	-	-	-	1.94	3.01	740

Q_p = Discharge; h= Surcharge height; S = Storage in inches

NOTE: Outflow discharge values are computed as per COE guidelines.

A. Size Classification — Curran Upper Reservoir Dam

Height of dam = 30.0 ft.; hence SMALL

Storage capacity at top of dam (elev. 331.5) = 501 AC-FT.; hence SMALL

Adopted size classification SMALL

B. Hazard Potential

This dam is located 2000 feet upstream of Curran Lower Reservoir in the City of Cranston. Public recreation is allowed at this reservoir. Overhead powerlines can be damaged. Dam failure could also result in overtopping of the lower reservoir and flooding and property damage to approximately 10 dwellings.

C. Adopted Classifications

HAZARD	SIZE	TEST FLOOD RANGE
SIGNIFICANT	SMALL	Full PMF to Half PMF

Adopted Test Flood = Half PMF = 1000 CSM

= 930 CFS

D. Overtopping Potential

Drainage Area = 0.93 sq. miles

Spillway crest elevation = 328.0 NGVD

Top of Dam Elevation = 331.5 NGVD

Maximum spillway discharge Capacity without overtopping of dam = 923 CFS

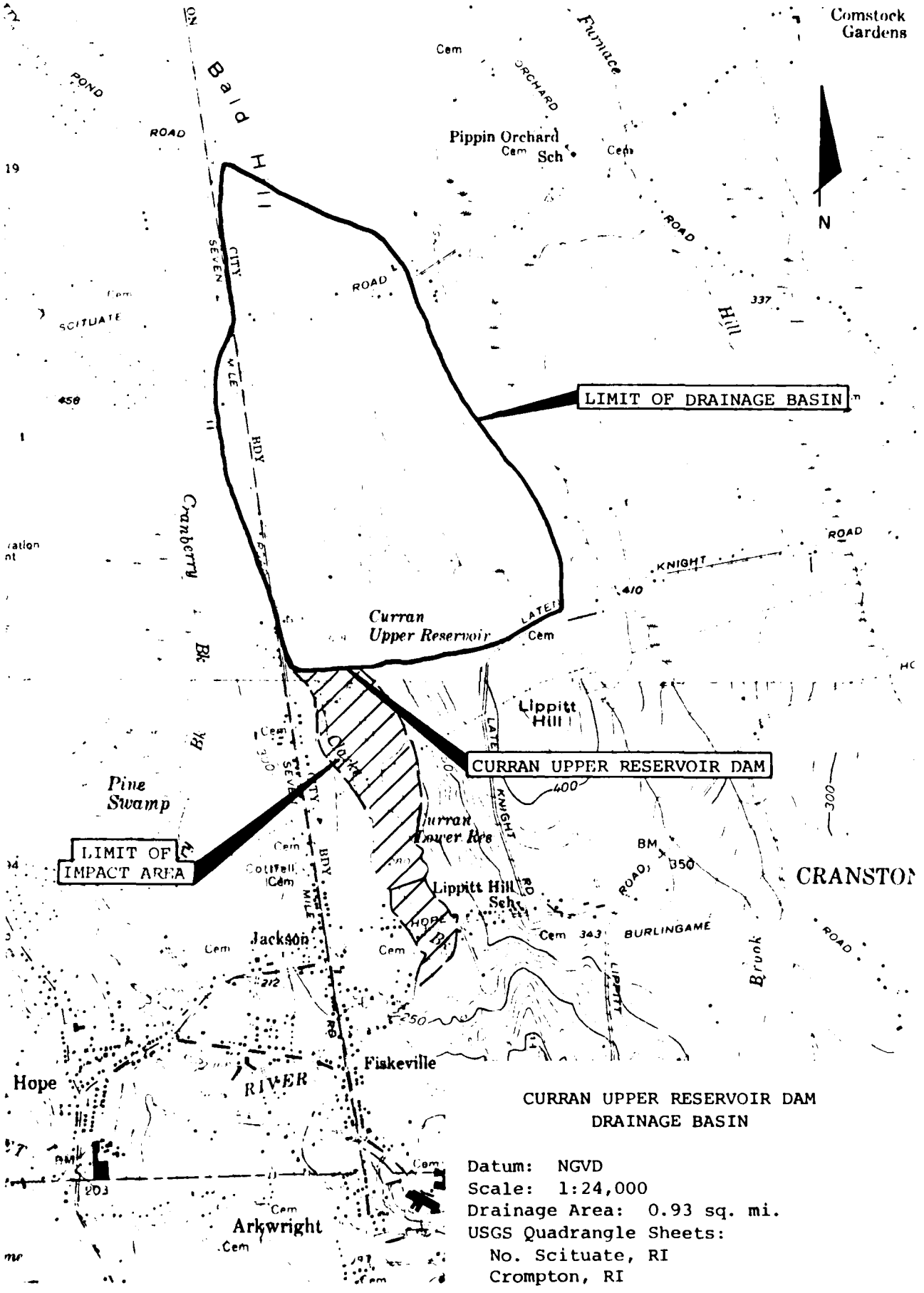
"test flood" inflow discharge = 930 CFS

"test flood" outflow discharge = 740 CFS

% of "test flood" overflow carried by spillway without overtopping = 100%

"test flood" outflow discharge portion which overflows over the dam = 0

% of test flood which overflows over the dam = 0%



CURRAN UPPER RESERVOIR DAM
DRAINAGE BASIN

Datum: NGVD
Scale: 1:24,000
Drainage Area: 0.93 sq. mi.
USGS Quadrangle Sheets:
No. Scituate, RI
Crompton, RI

PLATE D-1

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

NOT AVAILABLE AT THIS TIME

END

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